# CHILDREN'S ORGANIZATION AND DEVELOPMENT OF EMOTION: ATTACHMENT RELATIONSHIPS, PERCEPTUAL ASYMMETRY, AND EXECUTIVE FUNCTIONING

BY

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## Abstract

The goals of present study were to examine the unique and interactive effects of preschool children's attachment security, perceptual asymmetry in the processing of emotion, and executive functioning (EF) on their recognition of different emotions, emotion expression, and social initiations among peers. A total of 65 three to five year-old children (37 girls, 28 boys) completed attachment story-stem doll plays, the Chimeric Faces Task (CFT) to assess perceptual asymmetry in the processing of emotion, and emotion recognition task. Head teachers of the children completed a standard EF. Observers documented children's frequency of expressed affect and valence of social initiations among peers in the preschool classroom. Consistent with attachment theory, secure children were more likely to recognize different emotions and expressed positive emotions more often than insecure children. Children's executive functioning was a unique predictor of children's negative affect expression and initiations above and beyond perceptual asymmetry, child age, gender, and language ability. Finally, attachment security was found to moderate the relations between flexibility, a subscale of EF, and children's positive affect expression. Children's capacities to modify behavior and affect to new situations affected their experience of positive emotion only when they were insecure. In contrast, secure children expressed positive emotions frequently regardless of their EF flexibility. The results of this study contribute to our understanding of the interconnectedness between emotion and cognition. In addition, the findings highlight the notion that attachment security plays a crucial role in capacities to embrace and express positive emotions in addition to buffering the negative effects of EF inflexibility on experiencing positive emotion.

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## Chapter One: Introduction

Emotion has been a longstanding interest in diverse fields of studies such as developmental, neurobiological, and cognitive psychology (e.g., Calkins, Dedmon, Gill, Lomax, & Johnson, 2002; Cassidy, 1994; Davidson, 1993, 1998; Eisenberg, Fabes, Guthrie, & Reiser, 2002; Fox et al., 1995; Heller, 2004; Labile & Thompson, 1998; Sroufe, 1996; Thompson, 1998). This is because emotion is a crucial component of human behaviors and experiences, and emotion is a complex construct that involves relational, cognitive, and neurobiological processes. Emotion is thought to communicate the individual's affect and feeling to others and to provide experiential contexts with meaning across life span (Ekman, 2004; Ekman, Campos, Davidson, & De Waals, 2003; Goldsmith, 2003). In addition, the development of emotional patterns of responding is believed to be social and relational (Sroufe, 1996; Thompson, 2000), and emotion is also considered to involve a set of neurobiological processes throughout all brain regions that include perception, attention, feeling and cognition (Heller, 2004). Recent empirical findings have also shown that emotion cannot be fully understood separately from cognition because emotion and cognition are dynamically interconnected (Bell & Wolfe, 2004; Pessoa, 2008). Accordingly, there is a consensus among scientists highlighting the need to integrate concepts and methods across multiple disciplines in order to fully understand the impact of emotion on developmental processes.

Despite the agreement that emotion is crucial and a complex process that includes relational, cognitive, and neurobiological components, most of the empirical data on emotion has been generated within disparate disciplines. For example, developmental researchers have argued that attachment relationships shape individual differences in emotional patterns and development (e.g., Bowlby, 1973, 1980; Cassidy, 1994; Sroufe, 1996). Attachment theorists and researchers

have shown that early relational experiences produce qualitatively different patterns of emotion and behaviors (Belsky, 1999; Laible & Thompson, 1998). Neuroscientists have revealed that regional brain activity plays an important role in processing of emotion (e.g., Davidson, 1993, 1998; Heller, 1990, 2004).Cognitive psychologists have also argued that emotion is closely associated with cognition and thus the study of emotion has to consider the interaction between emotion and cognition (Bell & Wolfe, 2004; Gray, Braver, & Raichle, 2002; Pessoa, 2008). Although these fields of study have independently contributed to the study of emotion, there are still gaps in our understanding of how relational, cognitive, and neurobiological factors work together to influence the development of emotion.

Due to recent advances in concepts and methods in developmental, cognitive, and neurobiological models, there are theoretically plausible reasons to examine the unique and interactive effects of factors across these domains on the development of emotion in early childhood. First, researchers have agreed that the structures and processes of brains are plastic in the early years of life (Schore, 2001; Siegal, 2001) and that social interactions in childhood have a substantial influence on children's cognitive and emotional development (Sroufe, 1996; Thompson, 1998). There is also a growing body of data on neural correlates of attachment relationships (see Coan, 2008). Particularly, children's right hemisphere advantages in the brain have also been thought to develop during childhood (Barth & Boles, 1999; Waitling & Bourne, 2007; Workman, Chilvers, Yeomans, & Taylor, 2006). Thus, it seems imperative to investigate neural and cognitive processes in the context of attachment relationships in early childhood.

Second, attachment theory suggests that attachment representations have affective, cognitive, and regulatory components (Bowlby, 1973, 1980; Schore, 2001; Sroufe, 1996). At the same time, cognitive researchers have argued that emotional and cognitive development are

dynamically related, and that these interrelations are crucial to fully understand both areas (Bell & Wolfe, 2004; Gray, Braver, & Raichle, 2002; Pessoa, 2008). In particular, the regulatory aspects of emotional and cognitive development are believed to be strongly associated across domains (Bell & Wolfe, 2004; Cacioppo & Berntson, 1999; Cole, Martin, & Dennis; 2004). Given that attachment security involves affective, cognitive, and regulatory behaviors as well as goal directed behaviors, it seems very reasonable to explore the associations between attachment security and executive functioning because both are regulatory and involve goal directed behaviors.

Based on these theoretical claims, recently, a few studies have explored the neural activities involved in the interaction between attachment security and cognition in a sample of adults (Edelstein & Gillath, 2008; Warren et al., 2010). These findings support the notion that the quality of early relational experiences is associated with the brain activity and cognition which especially reflect the regulatory aspects of development. Accordingly, the integration of attachment theory, research on cognition, and neurobiological approaches in preschool years can enhance our understanding of developmental processes regarding how relational experiences, higher-order cognitive systems and neurobiological attributes work together to affect emotion outcomes.

The preschool years are crucial in the study of the interplay between emotion and cognition because children's social worlds, cognitions, and language about emotion become differentiated, expanded, and integrated during this period (Bretherton, 1987). In addition, children's emotional understanding, self-awareness and identity are dramatically improved during the preschool years (Thompson, 2000). Finally, this period of development is important for examining emerging cognitive capabilities such as executive functioning which has been

shown to be critical for social and cognitive understanding (Sabbagh, Xu, Carlson, Moses, & Lee, 2006).

Taken together, the goals of this study are to critically examine three different approaches that are used to study children's organization of emotions, and to demonstrate how an integration of attachment theory, research on cognition, and neurobiological approaches to the study of emotion would contribute to the study of young children's organization of emotion. Children's organization of emotion is defined as including the recognition of different emotions, the experience of different emotions in a naturalistic context (i.e., the expression of affect), and the initiation of social interactions among peers that are positively and negatively valenced. These areas of emotion functioning have been shown to be important indicators of competence and relationship development in the preschool period (Denham, MacKinley, Couchoud, & Holt, 1990; Denham et al., 2003; Laible & Thompson, 1998; Sroufe, 1996)

The specific goals of this study were to (1) examine the associations between attachment security, children's emotion recognition, expression, and social initiations among peers; (2) investigate how different attachment patterns coded from doll play (avoidance and anxiety) are associated with children's recognition of emotion, expression of different emotions, and social initiations among peers; (3) investigate the associations between perceptual asymmetry in the processing of emotion, executive functioning, children's emotion recognition, expression, and social initiations in the classroom; and (4) investigate the interactive effects of attachment security, perceptual asymmetry, and executive functioning on children's recognition of different emotions, their expression of emotions in the classrooms, and their initiations of social interactions among peers.

## Chapter Two: Literature Review and Theoretical Framework

### Attachment Theory and Emotional Processing

Bowlby's attachment theory (1969, 1973, 1980, 1982) suggests that early relational experiences with primary caregivers play a crucial role in adaptive human development, especially social and emotional adaptation. He argued that a secure attachment relationship serves as a secure base from which to explore environments and as a safe haven when distressed (Waters & Cummings, 2000). Most important for this study, Bowlby argued that individual differences in attachment relationships are products of repetitive affective and regulatory interactions with primary caregivers as well as predictors of qualitatively different patterns of emotion processing (Bowlby, 1973; Cassidy, 2008; Main, Kaplan, & Cassidy, 1985; Thompson, 2000). If primary caregivers are available and responsive to their infants' needs, their infants are more likely to feel secure, have positive emotions, and be confident in expressing their emotions in an open and flexible way (Main et al., 1985). In contrast, if primary caregivers ignore or are inconsistently responsive to infants' distresses, their infants are more likely to feel insecure, have negative emotions while expressing their needs, and ultimately develop patterns of emotional responding that are either avoidant/suppressive (avoidant infants), or overly reactive (anxious infants) when faced with emotional challenge (Cassidy, 1994, 2008). Indeed, attachment theory explicitly proclaims that the process in which human beings develop and organize different emotions is fundamentally social and relational (Sroufe, 1996; Thompson & Goodvin, 2005).

Importantly, the quality of attachment relationships that results in different patterns of emotion responding are influenced by histories of relational experiences as well as one's mental representations of relationships that help to translate their actual experiences which Bowlby called "internal working models."Because the internal working model construct is crucial in

understanding enduring effects of attachment relationships and patterns of emotional responses, I will review this concept in more detail.

**Internal working models.** Infants develop their mental models of selves, others, and general relationships through affective and collaborative interactions with their caregivers. Based on the quality of interactions with their caregivers, secure infants are presumed to have beliefs about self as worthy and others as available, resulting in the experience of close and positive interactions with others (Bowlby, 1969, 1973, 1980, 1982). In contrast, insecure infants are thought to have beliefs about self as unworthy and others as unavailable when distressed, resulting in the expectation of distant or negative relationships with other people (Bowlby, 1969, 1973, 1980, 1982). Indeed, internal working models play a critical role in anticipating, interpreting, evaluating environments and events as well as guiding future behaviors in relationships (Bretherton, & Munholland, 1999, 2008; Labile, & Thompson, 1998). Attachment researchers have argued that internal working models might be the process which explains how early relational experiences influence later relationships with respect to cognition, emotions, and behaviors (Bowlby, 1980; Bretherton & Munholland, 2008). In particular, internal working models are presumed to be involved in many aspects of emotion processing in the context of relationships such as decoding emotional information, experiencing different emotions, and the regulation of emotion (Bretherton & Munholland, 2008; Sroufe. 1996). As such, IWMs are thought to play a crucial role in emotional, cognitive, and behavioral development in new relationships (e.g., Bost, Vaughn, Washington, Cielinski, & Bradbard, 1998; Bretherton, Ridgeway, & Cassidy, 1990; Sroufe, 1996).

IWMs have some unique features. Although internal working models are cognitive mental representations, they are differentiated from other general mental representations with

respect to “relation-specific” representations. Bowlby (1980) argued that a child’s mental representations of self are constructed and internalized through interactions with an attachment figure, and they become an attribute of the child. In addition, Bowlby exclaimed that internal working models are consolidated and become automatic and stable over time although they can be modified and updated. This is because internal working models serve as cognitive-affective filters which are involved in attention, emotional patterns, and guiding future behaviors (Bowlby, 1969, 1982; Bretherton & Munholland, 2008; Bretherton et al., & Cassidy, 1990; Main et al., 1985; Sroufe, 1996). This argument includes three important processes for explaining stability in internal working models. First, because children’s mental representations play an important role in evaluating experiences, several unexpected experiences cannot easily change children’s belief systems (Bretherton et al., 1990). Second, the relational patterns might be stable because mental representations are unconscious and thus habitual and automatic (Bretherton & Munholland, 2008). Third, although one person might want to change his/her habitual patterns in dyadic interactions, the other person might resist the change, ultimately returning to the old patterns (Bretherton & Munholland, 2008).

Bowlby’s theoretical notion of this association between attachment relationships and different organizations of emotion has been strongly supported by empirical findings. First, attachment security has been found to be related to emotional expressivity. For example, secure children tend to show more positive affect when they play with their friends compared to insecure children (Sroufe, Schrock, Motti, Laworski, & LaFraniere, 1984). In a longitudinal study, secure children (attachment security was assessed at 12 months) frequently showed sad feelings compared to insecure children when they lost in competitive games at 3 years of age, suggesting that secure children are open to both positive and negative emotions (Lutkenhaus,

Grossman, & Grossman, 1985). Finally, securely attached children at 14 months have been shown to exhibit significantly less fear and anger at 33 months in response to distress when compared to insecurely attached children (Kochanska, Aksan, & Carlson, 2005).

Second, attachment security has also been shown to be significantly associated with the knowledge of different emotions. For example, secure children have been shown to understand negative emotions better than insecure children even though there were no differences in their understanding of positive emotions (Labile & Thompson, 1998). In addition, secure children have been shown to have a better understanding of emotions in general (not in a relational context) as well as attachment-related emotions than insecure children (De Rosnay & Harris, 2002). This finding suggests that attachment security may facilitate an overall understanding of different emotions rather than being limited to attachment related emotions.

Third, the relations between individual differences in attachment security and emotion regulation have been documented by attachment researchers. Based on Ainsworth's classifications of different patterns of attachment (Ainsworth, Blehar, Waters, & Walls, 1978) researchers such as Cassidy (1994) have further articulated the relation between three different attachment patterns and emotion regulation. Specifically, secure children are open in their expression of emotions and use adaptive emotional strategies when distressed whereas insecure children use maladaptive strategies of emotion regulation such as minimizing their emotions (avoidant children) or emphasizing their emotional expression (ambivalent children). Substantial empirical findings support these associations. For example, securely attached children have been found to use adaptive coping strategies and these constructive emotional regulation strategies have been shown to mediate the association between attachment and peer competence (Contreras, Kerns, Weimer, Gentzler, & Tomich, 2000). More recently, Kerns, Abraham, Schlegelmilch, and

Morgan (2007) found that secure children had more positive emotionality and effective strategies of emotion regulation irrespective of child temperament when compared to insecure children. This finding suggests the independent effect of early relational experiences on individual differences in emotion process regardless of temperament.

In addition, qualitatively different patterns of emotional response are a core criterion in the evaluation of attachment relationship across the life span using an array of methodologies (Ainsworth et al., 1978; Bretherton et al., 1990; Emde, Wolfe, & Oppenheim, 2003; Roisman, 2007; Roisman, Tsai, & Chiang, 2004). In infancy, attachment security is typically assessed using the Strange Situation (SS) laboratory procedure. The SS was developed by Ainsworth and her colleagues to assess infants' attachment security based on their different patterns of emotional response and secure base behavior during separation and reunion from their primary caregivers (Ainsworth et al., 1978). Using this procedure, decades of research has revealed that secure infants are easily calmed down by their caregivers and readily play with toys after reunion with their caregiver during the SS. In contrast, insecure infants show two different patterns of emotions and behaviors, especially after reunion. Insecure/avoidant infants avoid their caregivers when they return; they are less likely to play with toys and show much distress after separation. Insecure/anxious infants remain aroused and anxious and the level of their play is still subdued even after reunion. Disorganized infants are characterized as having incoherent patterns of emotion. During separations and reunions in SS procedure, they might exhibit inconsistent patterns of behaviors (avoidant or ambivalent) or typically show odd behaviors such as screaming for caregivers while away, then running away when caregivers return, or freezing (Ainsworth et al., 1978; Main & Hesse, 1990).

These distinctive emotions and behaviors related to attachment threats among secure,

insecure/avoidant, and insecure/anxious infants suggest that the quality of attachment relationships might reflect individual differences in the patterns of emotion regulation. Indeed, secure attachment relationships might play a crucial role in effective strategies of emotion regulation whereas insecure attachment relationship might provide ineffective patterns of emotion regulation (avoidant or resistant) (Bowlby, 1973, 1980; Cassidy, 1994; Roisman et al., 2004).

As children move beyond the sensorimotor period, narrative methods have been developed to more directly assess attachment representations. The MacArthur Doll-Story Stem Procedure is a story completion task developed by the MacArthur group (Bretherton, Oppenheim, Buchsbaum, Emde, & MacArthur Narrative Group, 1990) for evaluating young children's attachment security and representations. During the Doll-Story Stem Procedure, attachment-related story stems are presented and initiated by an interviewer and then young children are asked to create stories based on the story stems. Stories are presented along with a doll house and family figures (mother, father, and two children) who appear in stories to facilitate children's dramatic involvement in the vignettes. Narrative-based measures are designed to directly assess children's attachment representations and security through the content and process of their narratives about attachment related themes (Bretherton et al., 1990; Oppenheim, Nir, Warren, & Emde, 1997; Page & Bretherton, 2003).

Individual differences in patterns of emotion are also core criteria used to assess attachment security and representations using this methodology. Secure children are thought to have positive emotions about their parents and effectively resolve the attachment-related conflict using their parents as a secure base. Insecure young children are thought to have negative emotions (angry or unavailable) or ambivalent emotions about their parents and are typically

ineffective in resolving attachment-related conflicts. Likewise, the emotional patterns and strategies of resolving attachment related issues are also a crucial component of assessing the quality of attachment relationships in this narrative approach (Bretherton et al., 1990; Laible, 2006).

The most widely used and validated assessment tool of adult attachment is the Adult Attachment Interview (AAI; George, Kaplan, & Main, 1984, 1985, 1996; Hesse, 1999; Main et al., 1985). The AAI is a semistructured interview about the effects of early attachment experiences that include emotionally charged memories such as loss, rejection, separation, and trauma on their development as adults and as parents. The most important aspect of assessing adult attachment in AAI is the integration and coherency of their experiences in their narratives regardless of whether their early experiences are positive or negative in nature (Main & Goldwyn, 1984, 1998). Importantly, attachment researchers have argued (Kobak, Cole, Ferenz-Gillies, Fleming, & Gamble, 1993) and recently tested that the quality of adult attachment reflects qualitatively different patterns of emotion regulation, particularly with respect to the integration of emotion (Roisman, 2007; Roisman et al., 2004). Secure adults are thought to produce emotionally integrated accounts of their early experiences. That is, the valence of actual experiences and their emotional expression is consistent whether or not their experiences are positive or negative in nature. In contrast, insecure/dismissing adults are presumed to suppress their negative emotions by denying the impact of early experiences such as idealizing their caregivers or normalizing hard memories. Insecure/preoccupied adults are presumed to be caught up in their early experiences, resulting in producing inconsistent account of their experiences (Roisman, 2007; Roisman et al., 2004).

Taken together, the research supports the notion that individual differences in attachment

relationships result in qualitatively different patterns and strategies of emotional responding across the lifespan. Indeed, the core aspect of attachment relationships is social context for regulating emotional distress as well as physical protection (Bowlby, 1973, 1980; Coan, 2008). Although there are explicit theoretical notions and empirical findings which support the association between early relational experiences and qualitatively different patterns of emotion, our understanding of the dynamic processes of emotion underlying attachment security is still elusive. This is because emotion that is involved in attachment is thought to also be associated with cognitive processes but the mechanism of interconnectedness between emotion and cognition underlying attachment is not clear yet (Belsky, Spritz, & Crinic, 1996; Bretherton & Munholland, 1999, 2008). Therefore, I will review the association between emotion and cognition, especially focusing on attachment and higher-order cognition.

**Interconnectedness Between Emotion and Cognition**

Although emotion and cognition were traditionally considered as separate constructs, recently, a growing number of researchers have focused on the interconnectedness between emotion and cognition (Bell & Wolfe, 2004; Gray et al., 2002; Pessoa, 2008; Wolfe & Bell, 2007). In particular, some developmental researchers have argued that the regulatory aspects of emotional and cognitive development can be intricately related (e.g., Bell & Wolfe, 2004; Cacioppo & Berntson, 1999; Cole et al., 2004). This argument is based on the assumption that both emotional and cognitive development can be separated into two components (understanding and control) and each component is distinct but dynamically interconnected (Blair, 2002; Leerkes, Paradise, O'Brien, Calkins, & Lange, 2008). Understanding processes refer to awareness, recognition, and identification of expressive cues which include emotion and cognition. Control processes refer to reactivity and regulatory skills related to affect and

behaviors in social and nonsocial contexts.

Dividing emotion or cognition into two components can be found in several models. In the study of emotion, both Saarni's (1999) emotional competence model and Halberstadt, Denham, and Dunsmore's (2001) model of affective social competence propose that emotional understanding and emotional control are distinct processes although they are closely associated. In research on cognition, Perner, Lang, and Kloo (2002) suggest that theory of mind (cognitive understanding) should be differentiated from executive functioning (cognitive control). Leerkes et al (2008) also found that emotional understanding was significantly related to cognitive understanding and preschool children's ability to regulate emotion was significantly associated with their executive functioning during a Stroop Test. In addition, the two components approach is partly consistent with the argument that "knowing" about emotion has to be differentiated from "production or experience" of emotion (Davidson, Jackson, & Kalin, 2000; Heller, 2004). Based on previous approaches and models, it seems reasonable to divide emotion and cognition into two components (understanding and control) as well as to examine the interconnectedness between these two areas in order to more fully understand complex developmental processes related to emotion.

Furthermore, additional lines of research provide a rationale for addressing the association between emotion and cognition. Cognitive neuroscientists have tried to identify whether the neural mechanisms underlying emotion are consistent with those underlying cognition which reflect the integration of emotion and cognition. For example, Gray et al. (2002) found that cognition related neural activities in the lateral prefrontal cortex are influenced by emotional states, which suggests the interaction between emotion and cognition. Posner and colleagues (Bush, Luu, & Posner, 2000) also found that the anterior cingulated cortex (ACC),

which is considered to have two separate subdivisions to process emotion and cognition, is related to attention processes which regulate both emotion and cognition as well as integrate them. Particularly, in this neural mechanism underlying integration between emotion and cognition, cognitive processes generally refer to higher-order cognitive processes such as attention, working memory, and goal-directed control.

Further important evidence of addressing the associations between emotion and cognition can be found in deficits in both emotion and cognitive abilities in psychopathology (Nigg, Blaskey, Huang-Pollock, & Rappley, 2002). In general, children who have disorders such as ADHD or autism show poor emotion regulation as well as deficits in cognitive processing. In addition, weakness in cognitive processing has been shown to be related to externalizing behaviors such as substance abuse, addictive disorders as well as internalizing problems such as anxiety disorders and borderline disorders in studies of adults (Blume & Marlatt, 2009; Stevens, Kaplan, & Hesselbrock, 2003). This also suggests that emotion and cognition are interconnected and work together to influence the control of thoughts and behaviors.

Based on these findings, researchers have recently recognized and tried to investigate the interplay between emotion and cognition. Unfortunately, most data which examine the integration between emotion and cognition have focused on temperament which indexes emotion because temperament is thought to be a neuropsychological construct and is closely related to regulatory behaviors (Henderson & Wachs, 2007; Leerkes et al., 2008; Wolfe & Bell, 2007). Attachment, another important regulatory construct which also involves emotion and cognition, has rarely been explored in terms of the integration of emotional and cognitive development. In addition, a few empirical findings which show the interaction between emotion and cognition by attachment researchers have more generally focused on the effects of attachment on information

processing related cognitive abilities such as attention or memory (Atkinson et al, 2009; Zeijlmans van Emmichoven, Van IJzendoorn, Ruiter, & Brosschot, 2003). Although these findings have contributed to the understanding of the interaction between attachment and cognitive abilities, the interaction between attachment and executive functioning, in particular, has been neglected.

There are theoretical reasons to examine the association among attachment, executive functioning (the regulatory aspects of cognition), and emotion regulation (the regulatory aspects of emotion). First, developmental researchers have argued that the regulatory aspects of emotional and cognitive development are related and dynamically influence execution of behaviors (Bell & Wolfe, 2004; Wolfe & Bell, 2007). If attachment security is characterized as an affective, cognitive, and regulatory construct, it seems imperative to investigate the association among the regulatory aspect of emotion and cognition, and attachment security which also involves a regulatory component.

Second, attachment researchers have suggested that children's qualitatively different patterns of emotion processing/regulation are related to the achievement of the goal of maintaining proximity to caregivers (Bowlby, 1982; Cassidy, 1994; Thompson, 1994). If attachment patterns and security play a role in emotion regulation and goal directed behaviors (accompanying different emotions), there might be some association among attachment security, executive function, and emotion regulation. The specific hypotheses will be discussed later.

Third, the neural regions which reflect the integration between emotion and cognition are considered to be the same regions as those involved in executive function as well as those in attachment security. Recently, the frontal regions of the brain which have traditionally been presumed as a genetic indicator of temperament (e.g., Calkins & Fox, 1994; Calkins, Fox &

Marshall, 1996; Fox, Calkins & Bell, 1994; Fox, Henderson, Rubin, Calkins, & Schmidt, 2001; Hane, Fox, Henderson & Marshall, 2008; McManis, Kagan, Snidman & Woodward, 2002) are also considered as central nodes in cognitive control system which are referred to as executive function (Pennington & Ozonoff, 1996; Pessoa, 2008) and have also been associated with individual differences in attachment relationships (e.g., Cohen & Shaver, 2004; Dawson et al, 2001; Gillath, Bunge, Shaver, Wendelken, & Mikulincer, 2005; Rognoni, Galati, Costa, & Crini, 2008). Thus, I will discuss executive function in more detail.

**Executive function.** Although there is no universally accepted definition, executive functioning has been referred to as "a set of higher-order neuro-cognitive processes that allow higher organisms to make choices and to engage in purposeful, goal directed and future-oriented behavior" (Suchy, 2009, p. 106). Executive function (EF) typically includes working memory, inhibitory control, cognitive flexibility, response selection, set shifting, selective attention, planning, and initiation (Pennington & Ozonoff, 1996; Suchy, 2009). That is, EF contains the cognitive abilities to inhibit impulses, use working memory, shift attention from one task to another, control attention, plan, start tasks, and flexibly alter goals and plans in times of change (Pennington & Ozonoff, 1996). These processes work together to make plans, start some tasks, modify our attention and behaviors when there are challenges and control impulses to achieve goals. These abilities are considered imperative for adaptation in academic and social lives and also for managing stress in daily life. Indeed, patients with brain lesions which damage EF have been shown to have many problems in behavioral and emotional regulation (Suchy, 2009). The famous patient Phineas Gage who had a severe injury to his frontal lobes recovered his physical health but he had much damage to his personality. He had severe problems in controlling his temper and impulses in daily life. Except for severe cases such as Phineas Gage, lesser damage

to EF influences mental health. For example, patients with traumatic brain injuries also demonstrate social and behavioral problems such as depression, anxiety, irritability, and other mental problems (Marschark, Richtsmeier, Richardson, Crovitz, & Henry, 2000).

Likewise, the problems in EF are closely related to emotional problems. This notion can be further confirmed by the substantial empirical findings documenting the associations between EF and psychopathology as well as by research linking EF and socioemotional functioning. Research which examines the association between EF and psychopathology has particularly focused on adolescents (see Riggs, Jahromi, Razza, Dillworth-Bart, & Mueller, 2006). Adolescents with poor EF have been shown to have significantly more internalizing problems such as attention deficit hyperactivity disorder (Fisher, Barkley, Smallish, & Fletcher, 2005; Pennington & Ozonoff, 1996) and autism (Lopez, Lincoln, Ozonoff, & Lai, 2005) as well as externalizing problems such as bullying (Coolidge, DenBoer, & Segal, 2004) and conduct disorder (Moffitt & Henry, 1989) compared to adolescents who have higher EF skills. In addition, in their study of childhood, Cole and colleagues found that preschool children with poor EF showed problems in controlling disruptive behaviors (Cole, Usher, & Cargo, 1993). In addition, Jahromi and Stifter (2008) demonstrated that preschoolers who had poor EF showed more negative emotional expression and used aggressive coping strategies compared to preschoolers with high EF. These results suggest that the difficulty in EF (cognitive control) can be associated with difficulty in emotion control, supporting the argument that the regulatory aspects of development might be intricately associated.

This argument is consistent with Blair's (2002) notion and is also supported by Leerkes et al's (2008) empirical findings. Blair suggested that emotion regulation might influence all aspects of other control systems (cognitive control as well as behavioral control). Leerkes et al

(2008) found significant relations between the understanding process and the control process across emotion and cognition in a sample of preschool children. That is, both emotion and cognition can be separated into two components such as understanding and control and each process is significantly associated in both areas. Importantly, it supports the notion that the regulatory aspect of emotion and cognition is related. They also suggested further research be carried out to clarify the neural mechanisms of processes of understanding and control which influence the different aspects of experience in both emotion and cognition (Leerkes et al., 2008).

In sum, recent developmental research has concluded that emotion and cognition do not necessarily involve separate mechanisms and that examining the interaction between them is imperative to identify developmental processes related to socioemotional and cognitive development. In addition, it seems important to identify different aspects of experiences such as understanding and control in the study of both emotion and cognition. Based on these notions, three specific hypotheses were tested in this study. First, it was hypothesized that executive functioning will be significantly associated with emotion regulation rather than emotion understanding (recognition) because the regulatory aspects of emotional and cognitive development might be closely related. Second, attachment security and executive functioning will be significantly related because both constructs have a regulatory component. Third, it was hypothesized that attachment security and executive functioning will influence different aspects of emotion outcomes. Specifically, attachment security will be related to all aspects of emotion processing (both emotion recognition and emotion experiences) whereas executive functioning will be associated with the experiences of emotion rather than emotion recognition.

**Hemispheric Asymmetry and Emotion Processing**

Advances in neuroscience have contributed to the documentation of the neural correlates

of emotion (Damasio, 1998; Davidson, Ekman, Saron, Senulis, & Friesen, 1990; Heller, Nitschke, & Lindsay, 1997). In particular, hemispheric asymmetry has been thought to play a crucial role in the processing of emotion (Davidson, 1993; Heller, 1990). Despite the agreement on the important role of hemisphere asymmetry in emotion processing, different models and methods have been proposed and used to tap into the regional activity of the brain associated with emotion (Demaree, Everhart, Youngstrom, & Harrison, 2005; Davidson, 1993, 1998; Heller et al., 1997). This is because emotion includes different aspects of experiences such as the perception of emotions, the expression of emotion, and regulation of emotion and also involves in different regions of brain activation which taps into different aspects of emotional experiences. In particular, neuroscientists have argued that the perception of emotion has to be differentiated from the experience of emotion (Davidson et al., 2000; Heller, 2004). Specifically, the perception of emotion refers to "knowing" about emotion, or the evaluation and interpretation of emotion that involves the decoding process of expressive cues associated with the right posterior regional activation of the brain. On the contrary, the experiences of emotion refer to "production" of emotion related to the asymmetry of prefrontal regions (Heller et al., 1997; Heller, 2004). Based on the multifaceted aspects of emotion associated with different regions of brain activation, two representative emotion models will be discussed.

**Approach and withdrawal model.** Davidson and colleagues have argued and documented that there are two distinct brain systems that underlie approach and withdrawal (Davidson, 1993, 1998; Davidson et al., 2000). They suggested that the approach system (which is associated with producing positive emotions) is related to the left prefrontal neural activation whereas the withdrawal system (which is associated with producing negative emotions) is related to the right prefrontal neural activation (Davidson et al., 2000). Their argument is based on

several lines of empirical findings. First, patients with depression consistently showed less activation in the left prefrontal regions as well as fewer approach behaviors in EEG studies (e.g., Heller et al., 1997; Henriques & Davidson, 1990). Second, brain lesion studies revealed that patients with damaged left brains experienced severe depressive symptoms and the degree of the depressive symptoms was associated with the physical closeness of the left prefrontal regions (Robinson & Downhill, 1995). In particular, the prefrontal region is thought to be a core system in which emotional information from other brain regions is combined and regulated (Davidson, 1993; LeDoux, 1995). Consistent with this argument, Miller and Cohen (2001) suggested that the prefrontal region of the brain is a convergence region of diverse information about both internal systems and external environments. Indeed, the prefrontal regions might play a crucial role in decision making and action planning related to emotion processing (Heller, 2004). As such, the approach-withdrawal model particularly focuses on the experience dimensions of emotion which are related to asymmetry in the prefrontal regions.

Generally, this model has investigated hemispheric asymmetry in two different lines of inquiry. In the first line of inquiry, individual differences in baseline EEG asymmetry have been considered as traits (Coan & Allen, 2004). For example, in a sample of adults, Nitschke et al. (2004) found that the lower baseline left prefrontal cortex played a mediating role in the relationship between depression and attention. Davidson and his colleagues consistently found in adult samples that resting left prefrontal EEG asymmetry was associated with approaches related to positive emotions whereas resting right prefrontal EEG asymmetry was associated with withdrawal related to negative emotions. They also revealed that the decreased activation of the right prefrontal region might be associated with reducing negative emotions. Research in child samples have found that 10-12 year old children with high fear and reactivity at 2 years old

showed higher baseline right frontal activity (McManis et al., 2002). In a sample of preschool children, Fox et al. (1995) demonstrated that socially competent children had higher left prefrontal EEG baseline activation while socially withdrawn children showed higher right prefrontal EEG baseline activation.

Second, EEG asymmetry has been investigated as individual differences in state-related changes in emotion (Coan & Allen, 2004). Davidson and his colleagues have examined variation in changes of EEG activation using various experimental paradigms. First, they found that there was a significant shift in EEG activation from left to right while participants watched happy films and then watched disgusting films (Davidson et al., 1990). In addition, participants who reported that they had positive emotions in daily life were found to have more positive expressions on their faces during an observation period than participants who reported having negative emotions in everyday life. They also responded more to positive films than negative films. Davidson and colleagues also examined individual differences in changes of EEG activation while undergraduates engaged in "win trials" and "lose trials" (Sobotka, Davidson, & Senulis, 1992). Undergraduate students showed higher left frontal activation while they were in "win trials" compared to those in "lose trials". Davidson's research group also compared variation in changes of EEG activation between real smiles and social smiles (Ekman, Davidson, & Friesen, 1990). They found higher left prefrontal activation while participants showed "Duchenne" (real) smiles compared to social smiles. In a sample of infants, they found the same results as in the study of adults. Specifically, Davidson and Fox (1982) found that while infants watched positive-emotion eliciting videos (actress exhibits smiles and laughter) they showed relatively greater activation in the left prefrontal regions than the right prefrontal regions. Taken together, the approach-withdrawal model focuses on the experience component of emotion and

suggests that EEG asymmetry might be both a mediator and moderator in the processing of emotion (Coan & Allen, 2004).

**Valence and arousal model.** Heller and her associates have argued that the patterns of brain activity are differentially associated with two dimensions of emotions such as valence and arousal (Heller, 1990, 2004; Heller et al., 1997). Valence is divided into positive versus negative whereas arousal refers to the intensity of emotion from low to high. Particularly, this model is differentiated from the approach-withdrawal model in the sense that it includes and integrates two dimensions of emotions. Different valences (negative or positive) of emotion are associated with different prefrontal regions of the brain (left-positive vs right-negative) whereas the arousal of emotion is associated with the level of the right posterior activation. Most importantly, this model expands the role of the right posterior hemisphere in the experience of emotion (the arousal aspect of emotion) as well as in the processing of emotional information (Heller et al., 1997). The studies of anger and depression in this model might be good example to show different levels of activity in the right posterior hemisphere in terms of the arousal aspects of emotion. This is because anger and depression are the same dimension of emotion with respect to valence but anger and depression are different in terms of the arousal aspects of emotion. Anger is involved in high arousal but depression is presumed to have low arousal. Accordingly, anger is associated with high activity in the right posterior region whereas depression is associated with reduced activity in the right posterior regions. (Heller, 2004).

This model has been supported by empirical findings such as the studies of brain damaged persons, depression studies, and anxiety studies (e.g., Heller, 1990; Heller et al., 1997; Levin, Heller, Mohanty, Herrington, & Miller, 2007; Spielberg, Stewart, Levin, Miller, & Heller, 2008). Furthermore, Heller and colleagues have consistently found that depression is associated

with reduced activity in the right posterior hemisphere in samples of adults and youth (Flynn & Rudolph, 2007; Heller, 1990; Heller et al., 1997).

In addition, this model can be differentiated from the approach-withdrawal model in the study of anger because anger is the same valence of emotion in both models but anger is a different aspect of emotion between the two models in terms of motivational aspects of emotion (Spielberg et al., 2008). In the approach-withdrawal model, anger is associated with left prefrontal activation which reflects approach systems whereas anger is associated with the right prefrontal activities in the valence arousal model because anger has a negative valence. In subsequent empirical findings by Harmon-Jones and his colleagues, they found that anger was consistently associated with relatively higher activation in left prefrontal regions than right prefrontal regions, which supported the withdrawal model (e.g., Harmon-Jones & Allen, 1998, Harmon-Jones & Sigelman, 2001; Harmon-Jones, Sigelman, Bohilg, & Harmon-Jones, 2003). Based on these findings, they suggested that anger might be associated with higher left prefrontal activation only when anger is associated with the approach motivational system.

However, critical issues still remain in the study of anger. First, the studies of anger associated with withdrawal systems are rare (Spielberg et al., 2008). Second, the few empirical findings involving anger showed mixed results (e.g., Wacker, Heldmann, & Stemmler, 2003). As such, more comprehensive studies are necessary to examine both the approach-withdrawal model and the valence arousal model, or both models might be revised to fully explain the association between hemispheric asymmetry and anger (Spielberg et al., 2008).

The study of hemispheric asymmetry in emotion processing has been carried out using the free vision Chimeric Face Task (CFT) (e.g., Barth & Boles, 1999; Heller et al., 1997; Levine & Levy, 1986; Levy, Heller, Banich, & Burton, 1983; Workman et al., 2006),

Electroencephalography (EEG) (e.g., Davidson et al., 1990; Sobotka et al., 1992) and functional magnetic resonance imaging (fMRI) (e.g., Nitschke et al., 2004).

In particular, for the identification and evaluation of emotional information, the CFT is the most common, convenient and widely used behavioral measure of the perception of facial affects (CFT; Levy et al., 1983). The CFT consists of the pictures of faces of which one half is neutral and the other half displays emotion on either the right or the left side of each picture. The CFT is scored according to the left visual field preferences (LVF) that reflect the right hemisphere posterior activity and the right visual field preferences (RVF) that reflect the left hemisphere posterior activity. Thus, the CFT score reflects the specialized activation in the right posterior regions (Heller et al., 1997). Research using the CFT measure has shown stability in laterality scores across time (Levy et al., 1983).

In samples of adults and youth, there have been empirical findings which support the right hemisphere bias in the perception of emotion (e.g., Borod, Koff, & Caron, 1983; Flynn & Rudolph, 2007; Heller et al., 1997; Levy et al., 1983). However, the findings for children have been controversial. Although Levine and Levy (1986) found the right hemisphere biases in processing of emotion for young children, Barth and Boles (1999) did not find the right hemisphere advantages for young children. Based on contradictory findings, Barth and Boles suggested that the lateralization of perceptual asymmetry in the processing of emotion might develop as the left hemisphere bias for language develops during childhood. Workman and colleagues (2006) investigated the lateralization for recognition of emotions in three different age groups of children from 5 to 11 years of age. They did not find the right hemisphere bias in 5to 6 year-old children, but they found the right hemisphere advantages in 10 to 11 year-old children. In addition, the degree of the right hemisphere advantage was found to be significantly

associated with the ability to recognize emotions. These findings support Barth and Boles' suggestion that young childhood might also be a critical period for the lateralization of the perception of emotion.

In sum, relevant to this study, perceptual asymmetry plays an important role in the identification and evaluation of emotional information. However, it is still unclear about when the lateralization for the perception of emotion emerges as well as the consequences of individual differences regarding this lateralization. Thus, this study explores whether lateralization for the perception of emotion is established even in young preschool childhood. In addition, this neurobiological disposition might be influenced by early relational experiences. This is discussed next.

**Linking Attachment Security, Perceptual Asymmetry, and Executive Functioning**

The purpose of this study was to specifically examine three different domains of influence (attachment security, executive functioning, and perceptual asymmetry in the processing of emotion) on children's experience and recognition of emotion. We also explored the possible interrelations among these different areas of influence. Attachment theory explicitly suggests that individual differences in attachment security are associated with variations in emotion processing such as recognizing, understanding, and regulating emotion (Bowlby, 1969, 1982; Cassidy, 1994; Thompson, 1998). Attachment theory highlights that attachment relationships are significant social contexts for children not only to learn how to express, understand, and regulate emotions within affective and regulatory interactions with caregivers, but also to experience the most diverse and intense emotions (Sroufe, 1996). In addition, empirical findings have supported the notion that the qualitatively different patterns of attachment relationships are associated with the different patterns of emotion processing (e.g.,

Cassidy, 1994; Contreras et al., 2000; Kerns et al., 2007; Labile & Thompson, 1998; Sroufe et al., 1984). In particular, internal working models, which are posited to explain how the effects of early relationships affect later social and emotional adaptations, are thought to be cognitive-affective filters for interpreting and evaluating emotional information as well as for guiding future behaviors. That is, internal working models are presumed to be involved in decoding emotional information as well as in actual experiences and the regulation of emotion. In addition, IWMs play a provocative role in cognition and behaviors. Indeed, IWMs are a multifaceted construct which dynamically influence social, emotional, cognitive, and behavioral development (Thompson, 2000). Accordingly, there is a consensus among developmental researchers that attachment security is one of the most crucial influences on young children's organization and development of emotion (Bowlby, 1973, 1980; Sroufe, 1996).

However, different patterns of emotion processing are associated not only with attachment security but also with the regional activity in the brain. Specifically, frontal EEG asymmetry which is involved in the experiential aspects of emotion in the brain has been investigated in relation to individual differences in attachment security (e.g., Cohen & Shaver, 2004; Dawson et al., 2001; Gillath et al., 2005; Rognoni et al., 2008). This is because the organization of emotion in the approach withdrawal model is theoretically consistent with the organization of emotion in attachment theory. In particular, attachment security plays an important role in the development of secure base behavior which facilitates the exploration of new stimuli (producing approach related positive emotions) and a safe haven in times of distress (producing withdrawal related negative emotions) (Waters & Cummings, 2000). In contrast, insecurity provides non-optimal conditions of processing of emotions in the brain resulting in inflexible patterns of emotional responses such as withdrawal or over arousal (Coan, 2008;

Schore, 2001; Siegel, 2001).

Based on this theoretical relevance, there has also been an increasing body of empirical findings which support the relationship between attachment security and frontal asymmetry. In a sample of infants, Dawson et al. (2001) found that infants with depressed mothers had significantly less left frontal brain activation than infants with non-depressed mothers. In addition, they argued that insecure infants showed less left frontal activity than secure infants regardless of their mothers' depression symptoms. In a recent study of adults, Rognoni et al. (2008) also found that avoidant adults had significantly more activation in the right hemisphere but reported lower levels of arousal in self-reports than secure adults whereas preoccupied adults had significantly more activation in the left hemisphere and reported higher levels of arousal in self-reports than secure adults when they watched films depicting positive emotions. Taken together, the role of early relational experiences in examining neural mechanisms of the actual experiences of emotion seems reasonable and also has been supported by empirical findings.

Although empirical findings are accumulating which relate the actual experiences of emotion to hemispheric asymmetry as a function of attachment security, surprisingly, there are no empirical findings for the association between attachment security and the regional activity of the brain which reflects the perception of emotion. Studies of neural activity related to attachment relationships while people perceive or evaluate emotional cues have relatively been overlooked. The right posterior regions, which are one of important brain regions related to emotion processing, have been widely known as associated with the perception and identification of emotional information in neuroscience (Heller et al., 1997). Attachment security is thought to be involved in both the perception of emotion and the actual experience of emotion. Thus, documenting the association between the two approaches would expand the effects of attachment

on the different aspects of neural correlates of emotion, especially in a sample of young children. Ultimately, this study would bridge a gap in the study of emotion which investigates the regional brain activity associated with attachment relationships by adding a decoding aspect of the neural correlates of emotion (which is related to the right posterior hemisphere activation) as a function of attachment security.

In addition, there have been increasing calls for exploring the interconnectedness between emotion and cognition in order to understand the complex mechanisms of emotion (Bell & Wolfe, 2004; Gray et al., 2002; Pessoa, 2008). Recently, researchers have suggested that mechanisms accompanying emotion, cognition and behavior might occur in an integrated way rather than each acting separately (Blair, 2002; Leerkes et al., 2008). This suggestion is compatible with development researchers' claims that the regulatory aspects of development could best be understood in the association between emotion and cognition rather than considering emotion and cognition as separate constructs (e.g., Cacioppo & Berntson, 1999; Cole, Martin, & Dennis, 2004). Given that individual differences in the processing of emotion are related to achievement of the goal of maintaining proximity to caregivers (Bowlby, 1982; Cassidy, 1994; Thompson, 1998), executive function which also plays a crucial role in controlling goal directed behaviors is expected to be associated with the regulatory aspects of emotion which include the expression and regulation of emotion, and attachment security. Accordingly, it is theoretically plausible to expect that attachment security, EF and emotion regulation might be closely related because they have regulatory components.

A growing body of literature has documented the associations between psychological constructs which are usually related to attachment security and EF, such as the theory of mind and EF (Carlson, Mandell, & Williams, 2004), socio-emotional competence and EF (Brophy,

Taylor, & Hughes, 2002; Hughes, White, Sharpen, & Dunn, 2000; Riggs et al., 2006), psychopathology and EF (Blume & Marlatt, 2009; Stevens et al., 2003) and has revealed interactions between emotion and cognition. Nonetheless, very little empirical data are available that explore the direct association between attachment and EF in a sample of young children. In addition, there are little data that examine the interactive contribution of attachment, cognition, and neural activity related to decoding emotion to different facets of emotion (recognition and expression). In general, attachment research which examines the relation between cognition and attachment has shown selective biases in attention toward information that is related to attachment related expectations. That is, insecurity might play a role in inhibiting or interfering with attention and memory processes (Edelstein & Gillath, 2008; Zeijlmans van Emmichoven et al., 2003). However, these studies focus on the effects of attachment on cognitive functions rather than examining the dynamic interplay between attachment, cognition and emotion outcomes.

A recent fMRI study (Warren et al., 2010) has implications for understanding the interplay between emotion and cognition by examining the effects of attachment on cognitive control in a sample of adults, although it did not examine the direct association between attachment and EF. They found that insecure adults showed more brain activity in prefrontal cortical regions (e.g., right orbitofrontal cortex) which reflected emotion regulation and more left-frontal activations (DLPFC and dACC) which implemented cognitive control under emotional challenge. These results enhance our understanding of brain mechanisms through which attachment security could influence cognition and brain activity in a sample of adults. However, these types of association have not been readily explored in samples of young children. Thus, this study explored whether or not EF is associated with attachment security, as well as

whether EF is more related to emotion expression than emotion recognition in a sample of young children.

**Summary and the Purpose of the Study**

The above findings suggest that individual differences in attachment security, right posterior hemisphere activity, and executive function might be associated with qualitatively different patterns of emotion. Attachment theory explicitly claims that attachment security contributes to overall aspects of emotion processing which include the perception of emotional information as well as the actual experiences and regulation of emotion. On the contrary, activity in the right posterior hemisphere is thought to be particularly associated with the perception and identification of emotional information. Executive functioning which guides purposeful behaviors is expected to be related to the expression and regulation of emotion rather than the decoding aspects of emotion. By integrating these three approaches, this study explored the unique and interactive effects of the three approaches on children's recognition and expression of our hypotheses, based on this integration, are described below.

**Research Questions and Hypotheses**

The goals of this study are to integrate relational, cognitive, and neurobiological approaches in order to have a more comprehensive understanding of the multifaceted aspects of emotion during the preschool period. To address these goals, 4 research questions were addressed.

1. Is attachment security significantly associated with different facets of emotion processing (emotion recognition, emotional expression and social initiation among peers)? Based on previous findings which demonstrate robust and consistent associations between attachment and various aspects of emotion processing, it was hypothesized that attachment security would be significantly associated with different aspects of emotion processing. Specifically, secure

children would be more likely to recognize different emotions than insecure children. In addition, secure children would be more likely to express their positive emotions more often than insecure children when they played with their classmates.

2. Is the processing of emotion different between children who are categorized as avoidant and children who are categorized as anxious in doll play? Because attachment theory suggests that individual differences in attachment are related to qualitatively different patterns of emotion, it was hypothesized that different patterns of attachment would be associated with different patterns of emotional processing. Specifically, children who were categorized as avoidant in doll play would be less able to recognize different emotions than children who were categorized as anxious in doll play. In addition, children who were categorized as avoidant in doll play would be less likely to be emotionally expressive among peers than children who were categorized as anxious in doll play. These anxious and avoidant patterns of attachment were scored from the story completion task developed by the MacArthur group (see Methods below).

3. Is perceptual asymmetry related to emotion recognition and the expression of emotion? Is executive functioning more associated with the expression of emotion than emotion recognition? Based on the valence arousal model and research findings, we expected that a reduced right hemisphere brain activity would be related to relatively poor recognition of emotion. However, it should be noted that the lateralization of the right posterior hemisphere is not fully established in preschool period. The findings for the association between perceptual asymmetry and emotion recognition are mixed in samples of children whereas the data for adults are consistent. Thus, we would control the influence of child age when examining the association between individual differences in perceptual asymmetry and emotion recognition. We did not make a specific hypothesis about the association between perceptual asymmetry and expression

of emotion because there are no empirical data to date. We considered these analyses to be exploratory.

With respect to executive functioning, it was hypothesized that EF would be significantly associated with the regulatory aspects of emotion such as the expression of emotion or emotion regulation rather than the decoding aspects of emotion (emotion recognition). This is because the regulatory aspects of emotion are believed to be associated with the regulatory aspects of cognition. In addition, the brain region which taps into executive functioning is thought to be the same area where the regulatory aspects of emotion occur (i.e., prefrontal cortex).

4. Do attachment security, perceptual asymmetry, and executive functioning jointly influence children's recognition of different emotions, their expression of emotions, and social initiations among peers? Although there are no empirical data on examining the interactive effects of these three different domains (relational, neurobiological, and cognitive) on emotion outcomes, based on theoretical relevance and findings of the associations between emotion and cognition, they will have interactive contributions to how children recognize and express different emotions, and initiate social interactions among peers. Specifically, attachment security and perceptual asymmetry will jointly influence children's recognition of different emotions. In addition, children's expression of emotion and social initiations among peers will be jointly influenced by attachment security and executive functioning.

## Chapter Three: Methods

### Participants

A total of 70 three to five year-old children (40 girls, 30 boys) participated in this study. Children in this study were recruited from a university affiliated child development laboratory school in the Midwest of the United States. Among the 70 children, 5 were identified as left handed and were excluded from the analyses. Thus, the data from 65 children (37 girls, 28 boys) who were right handed were used in subsequent analyses. Children were on average 49.71 months of age (ranging from 32 to 70 months). Mothers were on average 37.14 years old (ranging from 20 to 45) and fathers were an average of 39.73 years of age (ranging from 26 to 50). Families were middle class in terms of income level and parent's education. All mothers had at least a bachelor's degree and 53.8% of mothers had a Ph.D. degree. All but one father had a bachelor's degree and 51% of fathers had a Ph. D. degree. With respect to parent's ethnicity, 28.8 % of mothers and 23.5% of fathers were Asian, 57.7% of mothers and 60.8% of fathers were Caucasian, 5.8% of mothers and 5.9% of fathers were Hispanic, and 3.9% of fathers were African American. For income, 82.7% of families earned greater than $55,000.

### Procedure

One laboratory assessment was conducted to obtain child attachment representation data and to assess children's perceptual asymmetry, and emotion recognition. Trained interviewers interacted with target children at least 6 hours in the childcare classroom in order to establish rapport with children before data were obtained. Classroom behavioral observations were conducted during the same semester when laboratory assessments were administered. Before beginning observation protocols, observers spent 3-4 hours conducting observations in each classroom in order to become familiar with all of the children in the classroom. Two trained

observers collected the frequency of emotional expression (positive, neutral, and negative valence) using a 6 second time sampling procedure. A different team of observers documented the frequency of positive, neutral, and negative social initiations among peers using a 15 second time interval sampling procedure. In addition, head teachers in the child care classroom provided ratings of executive functioning for each target child during the same semester that observations and interview data were obtained.

**Measures**

**Attachment representations/security.** Children's cognitive and emotional representations of caregivers were measured by a story completion task adopted from the MacArthur Doll-Story Stem Procedure (MSSB; Bretherton et al., 1990; Page & Bretherton, 2003). Two story stems (spilled soup and hurt knee) were used to elicit the attachment system of the target child. Stories were presented along with a doll house and family figures (mother, father, grandmother, and two children) which appeared in the stories to facilitate children's dramatic involvement in the vignettes.

Before presenting the story stems, an interviewer told children that they would make stories and the rule was that an interviewer would start the stories and the children would finish the stories. They started with a warm-up story to help children fully understand the procedure. The warm- up story had positive content (birthday party) which did not elicit the attachment system of children (there was no attachment threat). The story stems were presented in a counterbalanced order. An interviewer played a role in clarifying, facilitating, and inviting children's narratives by asking questions such as, "Show me and tell me what happens next," "Did anything happen in this story?" Children were also asked questions regarding the emotions of the individuals in the story such as "How did Sally feel when she spilled the soup?" The story

stem procedure lasted about ten minutes and the entire procedure was video-recorded and transcribed for coding (see Appendix A).

The narratives of the story stems were evaluated using the rating system developed by Bretherton and the MacArthur Narrative Workgroup (Oppenheim et al., 1997). Five areas of the story process were assessed, namely: (1) Avoidance (the subject's reluctance to deal with the attachment-relevant issue presented in the story or the entire task) (2) Anxiety (a sense of worry, apprehension, fear and distress in a response to the story or to the entire task) (3) Coherency (the substance of the story, how the problem of the story is dealt with) (4) Story Resolution (the level to which the problem presented in the story stem is not addressed or taken care of) (5) Security (the integrative perspective of coherency, fluency, resolution, emotional expressivity, knowledge of emotion, and representations of parents) (see Appendix B). Two raters coded separately and overlapped on over 67.1% of the coding. Differences were discussed and resolved during reliability checks, and the average scores of two ratings were used for analyses. Intraclass correlation was used for evaluating inter-coder agreement. Intraclass correlations (ICCs) for the five areas of process codes ranged from .88 to .98 ($M$ = 95.2). These results indicated satisfactory interrater agreement. Average scores were 2.45 ($SD$ = .86) for avoidance, 2.55 ($SD$ = .79) for anxiety, 4.43 ($SD$ = 1.14) for coherency, 2.19 ($SD$ = .70) for story resolution, and 4.27 ($SD$ = 1.16) for security.

In the coding of security, there was a rating scale that ranged from 1 to 8. There was also a categorical coding such that the transcriptions could be coded as avoidant or ambivalent. If children were restrained or withdrawn with interviewers or during the story stems, had no responses, or frequently said "I don't know," then the children were categorized as avoidant (a). If children tried to resolve the main attachment-related problems but the patterns of solving the

problems were resolution with a twist and digression, or not logical and understandable, the children were categorized as ambivalent (b). Two raters coded these separately and differences were completely resolved during reliability checks. If categorizations were different across two story stems for a child's transcription, raters went through transcriptions again and made decision about final category for those children. Consensus categories were used for subsequent analyses.

**Perceptual asymmetry.** Children's perceptual asymmetry of emotional processing was evaluated using the Chimeric Face Task (CFT) developed by Levy et al. (1983). The CFT consists of 36 pairs of split happy faces, sometimes the smile is on the right side and sometimes the smile is on the left side. Children were asked to point to the one which "looked happier" between two split faces (see Appendix C). Asymmetry scores are calculated based on children's preferences for left visual spaces (reflecting right hemisphere dominance) or right visual spaces (indicating left hemisphere dominance). The CFT score reflects the activation of the right posterior hemisphere of the brain which has been associated with the perception of emotion and arousal aspects of experiencing emotion (Spielberg et al., 2008). A high CFT score indicates low levels of activation in the right hemisphere which has been linked to depression in previous studies (Heller et al., 1997). Moreover, the 36-item CFT measure is considered to have high split-half reliability (Wirsen, Klinteberg, Levander, & Schalling, 1990). Because young children tend to have short attention spans, we used the 18-item version of the CFT ($M$ = -.07, $SD$ = .24, ranging from -.56 to .56).

**Emotion recognition.** Children's emotion recognition was evaluated using a standard emotion recognition protocol (Denham et al., 2003). An interviewer showed target children photographs of children's faces that were expressing the following emotions: happiness, anger, sadness, disgust, surprise, fear, and neutral. Children were asked to label the emotional state (i.e.,

"How do you think this person feels?") and to also explain why the child in the photograph might be feeling this way (see Appendix D). Scores were computed by summing the number of correct responses made by the child viewing the photographs. The mean score of the emotion recognition protocol was 3.45 (*SD* = 1.37). The scores ranged from 1 to 6.

**Emotion expression and initiation of social interaction.** Two trained observers collected 100 rounds of observation to assess the valence of children's emotion (positive, neutral, and negative) expressed during naturalistic classroom observations using a 6 second time sampling procedure. Using class rosters, observers started with the first child on the list and also noted how many children were in the classroom during the observation (see Appendix E). After every six seconds, observers recorded the valence (+, - , o) of affect being expressed by that child. One round of observation involved completing the entire class roster. In addition, a different team of two trained observers collected 100 rounds of observation to assess children's quality of social interaction among peers (positive, negative, neutral) using a 15 second time interval sampling procedure. In this procedure, working from the class roster, the observer notes every person with whom the child interacts during a 15 second interval. Additionally, the observer notes (1) who initiated the interaction and (2) if the interaction was positive, negative, or neutral. Scores for emotion expression and social initiation were obtained by summing the number of emotional expressions for each valence and the number of initiations of social interaction and then dividing by the number of rounds in which the target child was present. This is because target children might not have been present during the observation period because they were in the restroom, outside, or absent. Intraclass correlations (ICCs) for positive, neutral, and negative expression of emotion and initiations of social interaction ranged from .64 to .83 (*M* = 74.5). These results indicated satisfactory inter-observer agreement.

**Executive functioning.** Children's executive functioning was assessed using the Behavioral Rating Inventory of the Executive Functioning-Preschool Version (BRIEF-P; Gioia, Espy, & Isquith, 2003). The BRIEF-P is a standard rating scale which provides an assessment of children's daily behaviors associated with executive functioning for children between the ages of 2 to 5. Head teachers of the children in the preschool completed the 63 items based on their observations of the daily lives of the children in the preschool. Five aspects of children's executive functioning were evaluated (1) Emotional Control-10 items (2) Inhibition-16 items (3) Shift-10 items (4) Working Memory-17 items (5) Plan/Organize-10 items. A Global Executive Functioning Composite (GEC) score is derived as well as three overlapping clinical scales: Inhibitory Self-Control (Inhibition and Emotional Control); Flexibility (Shift and Emotional Control); and Emergent Metacognition (Working Memory and Plan/Organize; see Appendix F). With respect to the mean of clinical scales and Global Executive Composite, Inhibitory Self-Control was on average 39.84 (*SD* = 12.85, ranging from 26 to 68), Flexibility was on average 29.85 (*SD* = 8.45, ranging from 19.67 to 56), Emergent Metacognition was on average 35.12 (*SD* = 10.00, ranging from 27 to 73), and Global Executive Composite was on average 90.07 (*SD* = 23.49, ranging from 63 to 155).

The Global Executive Composite (GEC) is an overarching index score which summarizes and incorporates all of the BRIEF-P Clinical scales (i.e., Inhibitory Self-Control, Flexibility, and Emergent Metacognition). The Global Executive Composite (GEC) can be very useful when the three clinical scales are not substantially different. The Inhibitory Self-Control Index (ISCI) consists of the Inhibit and Emotional Control scales. The Inhibitory Self-Control Index (ISCI) reflects children's capacity to control behaviors and emotions. Children's capacities to regulate their behaviors and emotions are basic in executive functioning because they help to guide

systematic problem solving. The Flexibility index (FI) consists of the Shift and Emotional Control scales. The Flexibility (FI) scale reflects the degree to which children flexibly change or adapt their emotions, behaviors, and actions when they encounter new stimuli or environments. Flexibility is important because children need to adjust their responses, actions, behaviors, and emotions according to unexpected situations and environments (Isquith, Crawford, Espy, & Gioia, 2005). The Emergent Metacognition Index (EMI) consists of the Working Memory and Plan/Organize scales. The Emergent Metacognition Index (EMI) represents the extent to which children can maintain ideas and activities in working memory and plan and organize problems. Head teachers rated their responses from 1 (*never*) to 3 (*often*). All of the items were rated on a Likert-type rating scale. High scores on all three scales reflect students' difficulties in regulating emotions and behaviors, inhibiting impulses, adjusting to new environments, maintaining activities, and problem solving which is related to plan and organize ideas and thoughts (Isquith et al., 2005). Internal consistency (Cronbach's α) for teacher ratings on the preschool BRIEF scales and total scores are as follows: Emotional Control ($\alpha$ = .99); Inhibit ($\alpha$ = .99); Shift ($\alpha$ = .99); Working Memory ($\alpha$ = .99); Plan/Organize ($\alpha$ = .99); Global Executive Composite ($\alpha$ = .99). These results suggest that the BRIEF-P scales used in this study had very high internal consistency.

**Language ability.** Although we did not have a direct assessment of children's language skills, we did have the narratives that were generated by children during the birthday party "warming-up" story. We decided to use this story because it was the first story presented (so no immediate practice effects) and because there was no attachment-relevant threat in the story (and was not coded as part of the security score). Thus, a proxy for children's language ability was created by summing the total number of words used by the child to tell the story (or narrative

length). The mean of language ability was 45.21 (*SD* = 31.49). The scores of language ability ranged from 2 to 151.

## Chapter Four: Results

Results are comprised of four sections. First, data imputations were conducted for the treatment of missing values. Second, descriptive analyses were conducted to examine distributions and detect outliers. In addition, factor analyses were used to reduce the number of variables in the analyses that addressed the study hypotheses. Third, preliminary analyses were carried out to examine the influence of child age, gender, and language ability on all study variables. Fourth, the study hypotheses were tested using correlations, partial correlations, t-tests, and a series of hierarchical multiple regressions. In the first set of hierarchical multiple regressions, the unique and/or interactive contributions of attachment security and global executive functioning to emotion recognition were investigated. In the second set of hierarchical multiple regressions, the extent to which attachment security and flexibility made unique and/or interactive contributions to children's positive affect expression was examined.

### Data Imputation

Multiple imputation methods were used to maximize the number of participants that could be used in data analysis. Multiple imputation is a statistical technique in which missing values are replaced by multiple simulated values (e.g. 3-10) drawn from their predictive distribution (Schafer & Graham 2002). The goal of multiple imputation methods is to create several plausible sets of complete data for missing values. Multiple imputation methods are advantageous because they cover missing data uncertainty and a finite sample variation which is not reflected in other techniques such as case deletion, averaging available values, and single imputation (Schafer & Graham, 2002). Among various multiple imputation software programs (e.g., NORM, CAT, MIX, PAN etc.), NORM (Schafer, 2000), which uses an EM (expectation algorithm) to generate start values, was used for the treatment of missing values in this study.

This is because NORM is an appropriate multiple imputation program for multivariate continuous data under a normal model. The imputation model contains all the variables in the study (e.g., child gender, child age, child language ability, perceptual asymmetry, attachment, executive functioning, emotion expression, social initiations, and emotion recognition). Among 65 preschool children who participated in this study, for example, 48 children's emotion expression data were available because some children were absent in their classroom when observers observed the children's emotion expression, or the other children already left preschool before the observation periods started. Therefore, the data were missing at random and thus missing-at-random assumptions (Rubin, 1987) were not violated. The average percentage of missingness was computed by the total percentages of missingness divided by the number of study variables in the study. Although the percentage of missingness for children's emotion expression and executive functioning was 26.15% and 15.38%, respectively, the average percentage of missingness across all study variables was 9.3% because the percentages of other variables' missingness were not high. Based on Rubin's argument (1987) that three imputations are very efficient (97%) for data with 10% of missingness, three imputations were conducted. For out-of-range values in imputation data, these values were replaced with minimum or maximum values from the initial frequencies. Final results were obtained by computing an average of the three imputations.

**Descriptive Statistics and Data Reduction**

Descriptive statistics of all variables in this study are presented in Table 1 (before data imputations) and Table 2 (after data imputations), respectively. In order to reduce the number of variables, principal component analyses (PCAs) with varimax rotations were conducted for the 5 process variables of the story completion task and for the emotion expression and social

initiation data from classroom observations. These data were standardized before conducting the factor analyses. For descriptive and comparison purposes, PCAs were carried out utilizing data before imputations and again using data after imputations. The results of these principal component analyses are presented in Table 3 (story completion task), Table 4-1 (emotion expression and social initiations for data before imputations) and Table 4-2 (emotion expression and social initiations for data after imputations).

For the doll-play data, the results of the PCAs were the same when using the data before imputations and after imputations. These results yielded only one factor which accounted for 74.14% and 74.13 % of the variance, respectively (see Table 3). This component was comprised of the avoidance, story resolution, coherence, and security scores from the story-stem coding. This component was labeled as "Attachment Security," and was used as a composite score for attachment security in all subsequent analyses.

For emotion expression and social initiations, 3 emotion expression (positive, neutral, and negative emotion expression) and 3 social initiations (positive, neutral, and negative initiations) were also standardized before conducting the factor analyses. The results of the PCAs revealed a three factor solution (Eigen values over 1) that accounted for 83.54% and 84.19 % of the variance in the 3 emotion expression and 3 social initiation scores, respectively (see Table 4-1 and 4-2). The first factor consisted of positive affect expression and neutral affect expression, and explained 33.86% and 34.16 % of the variance, respectively. This factor was labeled as "Positive Affect Expression." The second component consisted of positive social initiations and neutral social initiations, and explained 24.96 % and 25.21 % of the variance, respectively. However, the direction of the loadings for positive social initiations and neutral social initiations were opposite when the data before imputations were compared to the data after imputations.

Thus, the second factor using data before imputations was labeled as "Neutral Social Initiations" whereas the second factor using data after imputations was labeled as "Positive Social Initiations." The third factor consisted of negative affect expression and negative social initiations, and explained 24.72% and 24.82 % of the variance, respectively. The third factor was labeled as "Negative Affect Expression and Initiations." Factor scores reflecting these 3 components were created and used in subsequent analyses. Correlations among all study variables are presented in Table 5 (data before imputations) and Table 6 (data after imputations).

**Preliminary Analyses**

Preliminary analyses were conducted to examine differences in the study variables as a function of child age, gender, and language ability. Child age was significantly associated with all aspects of emotion processing. Specifically, child age was significantly and positively correlated with emotion recognition ($r = .60$, $p < .001$) and positive affect expression ($r = .38$, $p < .01$.). In addition, child age was significantly and negatively correlated with positive social initiations ($r = -.31$, $p < .05$) and negative affect expression and initiations ($r = -.37$, $p < .01$). Child age was also marginally and negatively correlated with perceptual asymmetry ($r = -.24$, $p = .058$) suggesting that older children are more lateralized to the right hemisphere.

With respect to child gender, the results of t-tests revealed that boys were significantly more likely to express negative ($M = .43$) emotions and initiate negative social interactions ($t = 3.19$, $p < .01$), and marginally less likely to express positive ($M = -.25$) emotions ($t = -1.76$, $p < .10$) than were girls ($M = -.32$ and $M = .19$, respectively). In addition, teachers reported that boys were more likely to have difficulties in inhibitory self-control ($t = 2.68$, $p < .05$, $M = 44.43$) when compared to girls ($M = 36.36$).

Child language ability was found to be significantly and positively correlated with

attachment security ($r = .26$, $p < .05$), emotion recognition ($r = .42$, $p < .001$), positive affect expression ($r = .32$, $p < .01$) and flexibility ($r = .29$, $p < .05$). Based on these preliminary analyses child age, gender, and language ability were used as controls in all relevant analyses.

**Main Analyses**

The study hypotheses were tested using Pearson correlations, part correlations, t-tests, and a series of hierarchical multiple regressions. First, the associations among the predictor (i.e., attachment, perceptual asymmetry, and executive functioning) and outcome (i.e., emotion recognition, emotion expression and social initiations) variables were examined. Second, the relations between attachment security and different facets of emotion organization (i.e., emotion recognition, positive affect expression, positive initiations, and negative affect expression and initiations) were examined. Third, t-tests were conducted to examine whether or not children who were categorized as avoidant and anxious during the doll play scored significantly different on emotion variables. Fourth, the associations between perceptual asymmetry, executive functioning, and different facets of emotion outcomes were investigated. Finally, a series of hierarchical multiple regressions were conducted, based on the preliminary analyses, to examine the unique and/or interactive effects of attachment, perceptual asymmetry, and executive functioning variables on different facets of emotion processing.

**Interrelations among predictor variables: attachment security, perceptual asymmetry, and executive functioning.** Pearson correlations were conducted to examine the associations among the attachment security composite score, perceptual asymmetry, and executive functioning scores. No significant associations were found among attachment security, perceptual asymmetry and the 4 executive functioning scales (see Table 6). Further analyses were conducted using part correlations to explore these relations when relevant covariates were

considered (e.g., child age and gender were controlled for the association between anxiety and asymmetry, and child gender and language ability were controlled in the association between anxiety, inhibitory self-control and flexibility). No significant correlations were found (see Table 7). These results suggest that attachment security, perceptual asymmetry in the processing of emotion, and executive functioning are relatively distinct constructs.

**Interrelations among outcome variables: emotion recognition, positive affect expression, positive social initiations, and negative affect expression/initiation.** Correlation analyses were conducted to examine the relations among emotion recognition, positive affect expression, positive social initiations, and negative affect expression and initiations (see Table 6). Emotion recognition was significantly and positively correlated with positive affect expression ($r = .55$, $p < .01$). Emotion recognition was still significantly and positively correlated with positive affect expression even after child age and language ability were controlled ($r = .36$, $p < .01$) (see Table 8). No other significant associations were found except the association between emotion recognition and positive affect expression.

**Associations between attachment and emotion variables**. The relations among attachment and emotion outcome variables were examined using Pearson correlations and part correlations (see Table 9 and 10). Analyses revealed that attachment security was significantly and positively correlated with emotion recognition ($r = .27$, $p < .05$) and positive affect ($r = .38$, $p < .01$) (see Table 9). Attachment was still significantly and positively correlated with positive affect expression ($r = .29$, $p < .05$) even after child age and language ability were controlled. Thus, children who were more secure were significantly more likely to express positive emotions in the classroom when compared to less secure children, even after the significant effects of child age and language ability were considered. These findings support the hypothesis that secure

children will be more likely to express their positive emotions often than insecure children.

**Anxiety and avoidance.** T-tests were conducted to examine whether children who were categorized as avoidant or anxious in the doll play had different emotion recognition, expression, and social initiation scores (see Table 11). As expected, children who were categorized as avoidant in the doll play were less likely to recognize different emotions in emotion recognition task ($M$ = 2.98) than children who were categorized as anxious in the doll play ($M$ = 3.88) ($t$ = -2.79, $p$ < .01). In addition, children who were categorized as avoidant were less likely to express positive emotions ($M$ = -.27) in the classroom than children who were categorized as anxious in doll play ($M$ = .25) ($t$ = -2.18, $p$ < .05). However, children who were categorized as avoidant were *not* significantly less likely to be expressive in negative emotions ($M$ = .00) than children who were categorized as anxious in doll play ($M$ = .00) ($t$ = -.02, $p$ = ns). These findings partially support the study hypotheses regarding the relations between attachment avoidance/anxiety and emotion outcome variables. They support the notion that avoidant children have more difficulty recognizing different emotions than anxious children, but, interestingly, the expression of affect is significantly different only for positive affect and not for negative affect.

Further exploratory analyses were conducted to examine whether children who were categorized as avoidant in doll play were different from children who were categorized as anxious in doll play in terms of attachment, perceptual asymmetry, executive functioning, and language ability (see Table 11). The results of t-tests revealed that children who were categorized as avoidant in the doll play were significantly less likely to be fluent ($M$ = 36.54) in terms of language than children who were categorized as anxious in doll play ($M$ = 53.12) ($t$ = -2.18, $p$ < .05). In addition, children who were categorized as avoidant were significantly less likely to have difficulty in modulating behavioral and emotional reactions according to new environments

($M$ = 27.58) than children who were categorized as anxious in the doll play ($M$ = 31.92) ($t$ = -2.12, $p$ < .05). That is, children who were categorized as anxious were more likely to have problems in adjusting their emotions and behaviors to new stimuli than children who were categorized as avoidant in the doll play.

**Associations between perceptual asymmetry, executive functioning and emotion outcome variable.** Correlation analyses were conducted to examine the associations among perceptual asymmetry, executive functioning, and different emotion outcome variables (emotion recognition, positive affect expression, positive social initiations, and negative affect expression and social initiations) (see Table 12). Perceptual asymmetry was marginally and positively correlated with negative affect expression and social initiations ($r$ = .24, $p$ = .06). The global executive functioning composite score was significantly and positively correlated with emotion recognition and negative affect expression and social initiations, respectively ($r$ = .31, $p$ < .05 and $r$ = .43, $p$ < .01). In addition, the three clinical scales of the BRIEF-P were also associated with different facets of emotion processing. Inhibitory self-control was significantly and positively correlated with emotion recognition and negative affect expression and social initiations ($r$ = .31, $p$ < .05 and $r$ = .50, $p$ < .001). The BRIEF-P flexibility score was the only variable which was associated with all aspects of emotion processing. Flexibility was significantly and positively correlated with emotion recognition ($r$ = .44, $p$ < .01), positive affect expression ($r$ = .36, $p$ < .01), and negative affect expression and social initiations ($r$ = .45, $p$ < .001). In addition, flexibility was significantly and negatively correlated with positive social initiations ($r$ = -.25, $p$ < .05). Emergent metacognition was significantly and positively correlated with negative affect expression and initiations ($r$ = .33, $p$ < .01).

When relevant variables were controlled (e.g., child age, gender, or child language

ability), the results of part correlations indicated that the global executive functioning composite score was still significantly and positively correlated with emotion recognition ($r = .37$, $p < .01$) and negative affect and initiation ($r = .36$, $p < .01$) (see Table 13). In addition, new associations were found between the global executive functioning composite score and emotion variables when child age, gender, and language ability were considered. The global executive functioning composite score was marginally and positively correlated with positive affect expression ($r = .22$, $p < .10$) and was also significantly and negatively correlated with positive social initiations ($r = -.27$, $p < .05$) when the influence of child age, gender, and language ability were controlled. In addition, inhibitory self-control was still significantly and positively correlated with emotion recognition ($r = .40$, $p < .01$) and negative affect expression and social initiations ($r = .41$, $p < .01$) even after child age and language ability, and child age, gender and language ability were taken into account. When child age, gender, and child language ability were controlled, newly, inhibitory self-control was significantly and negatively associated with positive social initiations ($r = -.29$, $p < .05$) and was also marginally and positively correlated with positive affect expression ($r = .24$, $p < .10$). Flexibility was still significantly and positively correlated with emotion recognition ($r = .37$, $p < .01$), positive affect expression ($r = .32$, $p < .05$), and negative affect expression and social initiations ($r = .47$, $p < .001$) when the influence of relevant variables (child age, language ability and gender) were controlled. In addition, flexibility was still significantly and negatively associated with positive social initiations ($r = -.27$, $p < .05$) when child age, gender, and language ability were controlled. Emergent Metacognition was significantly and positively correlated with emotion recognition ($r = .28$, $p < .05$) when child age, gender, and child language ability were considered.

Interestingly, when relevant controls were used in the analyses examining the relations

between perceptual asymmetry and emotion outcomes, the relation between perceptual asymmetry and negative affect expression and social initiations was still marginally positive ($r$ = .21, $p$ = .055) but a new positive association between perceptual asymmetry and positive affect was found ($r$ = .25, $p$ = .054). This will be discussed in more detail in discussion section.

**Hierarchical Multiple Regression Analyses Predicting Children's Emotion Recognition and Children's Positive Affect Expression**

Based on the above correlation analyses, two hierarchical multiple regressions were conducted to examine the unique or interactive effects of attachment security and global executive functioning, and attachment security and flexibility on children's emotion recognition and positive affect expression, respectively. In predicting children's emotion recognition, child age and language ability were entered as covariates in Step 1. In Step 2, attachment security and global executive functioning were entered. In Step 3, the 2-way interaction term of attachment security and global executive functioning was entered. In predicting children's positive affect expression, child age and language ability were entered as covariates in Step 1. In Step 2, attachment security and flexibility were entered. In Step 3, the 2-way interaction term of attachment security and flexibility was entered. Scores for all variables (independent and dependent variables) and interaction term were standardized. As shown in Table 14, the interaction between attachment security and global executive functioning was *not* significant in predicting children's recognition of emotion. The interaction between attachment security and flexibility was significant in predicting children's positive affect expression (see Table 15).

The results of significant interaction between attachment security and flexibility in the prediction of children's positive affect expression suggested that the relation between flexibility and children's positive affect expression is moderated by attachment security. In order to clarify

the interpretation of this interaction, we plotted the slopes for the relation between flexibility and children's positive affect expression for insecure children (1 SD below M) and secure children (1 SD above M) (see Figure 1). In addition, post hoc test was used to determine whether a given slope was significantly different from zero (Akin & West, 1991). The results of post hoc test indicated that flexibility was significantly and positively associated with children's positive affect expression for insecure children ($\beta = 0.54$, $p < .05$). In contrast, these associations were non-significant in the prediction of positive affect expression for secure children ($\beta = 0.08$, $p =$ ns). Therefore, flexibility was positively related to children's positive affect expression only for children who were insecure. These findings suggest that children's emotional reactivity and difficulty in regulating their behaviors and emotions to new stimuli do not significantly influence children's abilities to express positive emotions when children are secure. Actually, the level of positive affect expression for secure children was high whether or not they were emotionally reactive and had difficulty in adapting their behaviors and emotions. In contrast, the frequency in which insecure children expressed positive affect was different depending on their emotional flexibility.

Based on the findings above, further examination of the relations between children's flexibility based on teacher reports and the disaggregated attachment in the doll play was carried out. T-tests were conducted to examine differences in anxiety and avoidance scores for insecure children with high flexibility and insecure children with low flexibility. The results of t tests indicated that insecure children who were emotionally reactive and had difficulty in regulating their behaviors and emotions were significantly and more likely to be anxious ($t = -2.1$, $p < .05$, $M = 3.32$) than insecure children who were not emotionally reactive ($M = 2.74$). In addition, insecure children who were not emotionally reactive and had less difficulty in regulating their

behaviors and emotions were marginally and more likely to be avoidant ($t = 1.68$, $p < .10$, *Mean = 3.27*) than insecure children who were emotionally reactive ($M = 2.82$). These results are consistent with the notion that anxious children are more likely to recognize different emotions and be emotionally expressive than avoidant children.

**Regression Models Predicting Attachment Security and Executive Function Variables**

Based on previous correlational analysis, eleven multiple regression models were conducted to explore whether or not emotion variables predicted attachment security and 4 EF variables (see Table 16). The results of Model 1 and Model 2 revealed that, controlling for child age and language ability, the Model 1 was marginally significant predicting attachment security but emotion recognition was *not* a significant predictor of attachment security ($\beta = .15$, $p =$ ns) whereas positive affect expression (Model 2) significantly predicted attachment security ($\beta = .33$, $p < .05$). Models 3 and 4 revealed that, controlling for child age, language ability, and gender, emotion recognition (Model 3) and negative affect expression and initiations (Model 4) significantly predicted inhibitory self-control ($\beta = 4.68$, $p < .01$ and $\beta = 5.56$, $p < .01$, respectively). Models 5, 6, 7, and 8 indicated that, controlling for relevant variables (i.e., child age, language ability, and gender), flexibility was significantly predicated by emotion recognition (Model 5, $\beta = 3.03$, $p < .01$), positive affect expression (Model 6, $\beta = 2.41$, $p < .05$), positive social initiations (Model 7, $\beta = -2.29$, $p < .05$), and negative affect expression and initiations (Model 8, $\beta = 4.36$, $p < .001$). Model 9 revealed that, controlling child age, language ability, and gender, the Model 9 was significant but negative affect expression and initiations was not a significant predictor of emergent metacognition ($\beta = 2.33$, $p =$ ns). Finally, Models 10 and 11 revealed that, controlling for relevant covariates (i.e., child age, language ability, and gender), emotion recognition (Model 10) and negative affect expression and initiations (Model 11)

significantly predicted global executive composite ($\beta = 8.55$, $p < .01$ and $\beta = 9.5$, $p < .01$, respectively).

## Chapter Five: Discussion

Documenting how children recognize, express, and regulate different emotions has been a longstanding goal in social science. This is because children's emotional development is so closely interconnected with their developing social competencies (Denham et al., 2003; Denham, MacKinley, Couchoud, & Holt, 1990; Laible & Thompson, 1998; Sroufe, 1996) and has been shown to predict important outcomes such as internalizing and externalizing problems (Eisenberg et al., 2000; Eisenberg, Hofer, & Vaughan, 2007). In particular, the preschool years are critical in children's emotional development because their social worlds, cognitions, and language about emotions become differentiated, expanded, and integrated during this period of development (Bretherton, 1987).

Because of the importance of examining children's emotional development, diverse fields of study have contributed to our understanding of children's organization and development of emotion including developmental, neurobiological, and cognitive psychology. Although each field of study has independently contributed to the study of emotion, there has been some consensus among researchers that an integration of concepts and methods across multiple disciplines is inevitable in order to fully understand the impact of emotion on developmental processes (Bell & Wolfe, 2004; Calkins, 2010; Cole, Marin, & Dennis, 2004; Schore, 2001; Pessoa, 2008). The goals of this study were to investigate how attachment security, perceptual asymmetry in the processing of emotion, and executive functioning were uniquely and/or jointly associated with children's recognition of different emotions, their expression of emotions in the naturalistic classroom environment, and their initiations of social interactions among peers. The specific objectives of this study were the following; (1) to examine the associations between children's attachment security, different attachment patterns coded from attachment narratives,

and children's emotion recognition, expression, and social initiations among peers; (2) to investigate the associations between children's perceptual asymmetry in the processing of emotion, executive functioning, and their recognition and expression of different emotions; (3) to examine the relative and/or interactive contributions of children's attachment security, perceptual asymmetry, and executive functioning to children's recognition and experience of emotion.

**Attachment Security, Attachment Patterns, and Emotion Outcomes**

As expected, we found that children's attachment security was significantly and positively associated with children's positive affect expression regardless of child age and language ability. Thus, these findings revealed that secure children were more likely to express (experience) positive emotions among peers than insecure children. These results are consistent with Bowlby's claim that individual differences in attachment relationships are the result of repetitive affective and regulatory interactions with primary caregivers as well as predictors of qualitatively different patterns of emotion processing (Bowlby, 1979; Cassidy, 2008; Main, Kaplan, & Cassidy, 1985; Thompson, 1990). Particularly, these results are consistent with empirical findings that secure children tend to express more positive emotions compared to insecure children (Kerns et al., 2007; Sroufe et al., 1984). That is, security affords the child a safeguard in which positive experiences are embraced and expressed. Interestingly, children's security was not significantly and negatively related to negative affect expression and initiations, although the direction of the association was as anticipated. This result suggests that secure children are *not* necessarily less likely to express negative emotions or to initiate negative social interactions among peers. This finding, in part, supports the notion in attachment theory that secure children are thought to be open to express both positive emotions and negative emotions (Cassidy, 1994, 2008; Labile & Thompson, 1998). Since secure children tend to express their

negative emotions when they feel/experience negative emotions, children's security may not be necessarily related to less frequency of negative emotion expression in daily interactions with friends. This finding supports the theoretical claim that secure attachment relationships are a source of joy under ordinary circumstances and the capacities to embrace and experience positive interactions in different relationships are a consequence of these experiences (Cassidy, 2008). In addition, this finding is particularly important in light of the findings in positive psychology that the frequency of positive emotions, not the intensity of positive emotions, is an indicator of happiness or affective well-being which is related to resiliency (Diener, Sandvik, & Pavot, 2009). Snyder, Lopez and Pedrotti (2010) also suggested that children's attachment relationships might provide the springboard that helps children to grow into happy adults by providing the security to experience positive emotions.

Results also revealed that different attachment patterns (i.e., avoidant and anxious) coded from story-stem narratives were associated with qualitatively different patterns of emotion processing in early childhood. Specifically, children who were categorized as avoidant were less likely to recognize different emotions in photographs and were less likely to express positive emotions among peers than children who were categorized as anxious. Consistent with Cassidy's claim (1994, 2008), these results demonstrated that avoidant and anxious children had qualitatively different patterns of emotional strategies and emotion regulation. Typically, children who have avoidant attachment patterns are not sensitive to emotional cues and are not expressive in positive emotions. This is because they usually dismiss and minimize emotional experiences and thus do not have opportunities to develop effective emotional strategies (deactivating strategy, see Kobak et al., 1993; Shaver & Mikulincer, 2010). In contrast, children who have anxious attachment patterns are vigilant to emotional stimuli and emphasize their emotions to

receive caregivers' interests, ultimately developing their emotional strategies in a way that is overly sensitive to emotional experiences (hyperactivating strategy, see Kobak et al., 1993; Shaver & Mikulincer, 2010). Importantly, this study documents these associations using naturalistic observations of peer interactions.

In addition to the above findings, the results of this study documented that children who were categorized as avoidant were significantly *less* likely to have difficulty regulating and shifting their behaviors and emotions according to new environments (flexibility scale from the BRIEF-P) than children who were categorized as anxious. The interpretation of this result also draws from a control theory (see Kobak et al., 1993; Mikulincer, Shaver, & Pereg, 2003; Shaver & Mikulincer, 2005, 2010). Researchers suggested that anxious children's continuous focus on emotional cues may exacerbate or overwhelm their emotions and that this may result in a difficulty regulating and shifting their emotions and behaviors. In contrast, avoidant children's dismissal of emotions may prevent creative and active exploration, but they externally do not seem have regulating problems compared to anxious children because they suppress their distress and typically do not express their negative emotions (Mikulincer et al., 2003). Indeed, they have argued that attachment theory is the most articulated and useful framework of emotion regulation. Taken together, these results contribute to literature by adding empirical evidence that different attachment patterns are associated with qualitatively different patterns of emotion processing such as emotional strategies and emotion regulation.

**Perceptual Asymmetry and Emotion Processing**

In neuroscience, perceptual asymmetry has been thought to play an important role in the identification and evaluation of emotional information (Davidson, 1993; Heller, 1990; Heller et al., 1997). Previous research has documented that a right hemisphere bias is consistently found in

the perception of emotions for adults and youth (e.g., Borod et al., 1983; Flynn & Rudolph, 2007; Heller et al., 1997; Levy et al., 1983) whereas the empirical findings of a right hemisphere bias for children is controversial (Barth & Boles, 1999; Levine & Levy, 1986; Workman et al., 2006). However, recently, a growing body of studies has shown that a right hemisphere bias is not clearly defined for younger children, but it may be established around when children are 10 years old (Waitling & Bourne, 2007).

It is speculated that the different findings on the right hemisphere advantage for children may be due to slightly different methodology across studies. Researchers who have used multiple expressions in CFT were more likely to find the right hemisphere advantage even in samples of children. For example, Barth and Boles (1999) failed to detect the right hemisphere advantage of emotion processing using only the pictures of happiness for children. However, Christman and Hackwork (1993) found children's laterality of the right hemisphere using 2 positive emotions (happiness and pleasant surprise) and 2 negative emotions (sadness and anger). Workman and his colleagues (2006) also found the right hemisphere advantages using six universal facial expressions (happiness, sadness, pleasant surprise, anger, fear, and disgust) for children aged 10-11, but not for children between the ages of 5 and 8. Waitling and Bourne (2007) documented that the right hemisphere advantage was found in 10 year-old children, although they only used the picture depicting happiness in CFT. These previous findings suggest that the right hemisphere advantage may be developing during childhood and assessing a wide range of emotions may provide a more complete picture of the laterality of the right hemisphere. In this study, although only the emotion of happiness was used to assess children's perceptual asymmetry, we still found that child age was negatively associated with a reduced right hemisphere bias, such that older children were more lateralized to the right hemisphere than

younger children even in early childhood. This result supports the notion that childhood is a critical period for the lateralization of the right hemisphere (Barth & Boles, 1999).

Although most studies in this area have typically focused on children's laterality of the right hemisphere in childhood, Workman and colleagues (2006) documented that a right hemisphere bias was associated with individual differences in children's emotion recognition in childhood. Watling and Bourne (2007) also found that older children who were more lateralized to the right hemisphere were more likely aware of the need to regulate negative emotions than younger children who were less lateralized to the right hemisphere. These two studies suggest that individual differences in the right hemisphere advantage may be closely related to qualitatively different patterns of emotion processing even in childhood.

Partially consistent with previous research, the data from this study indicated associations between individual differences in children's right hemisphere laterality and emotion processing. Specifically, we found that children's reduced right hemisphere activity was significantly related to children's negative affect expression and social initiations as well as positive affect expression when child age and gender were controlled, although children's right hemisphere advantages are theoretically expected to be related to children's abilities to recognize different emotions. Nonetheless, these results are worthwhile to note because they are some of the first to show associations between perceptual asymmetry and children's experience of emotion in everyday interaction among peers. This study particularly suggests that a reduced right hemisphere bias may be crucial for understanding children's expression of both positive emotions and negative emotions during preschool period. Taken together, this study contributes to literature by examining ways in which individual differences in children's perceptual asymmetry may be closely related to the experience of emotions even in early childhood as well as adding empirical

data pertaining to how the right hemisphere advantage is developing in the preschool period.

**Executive Functioning and Emotion Processing**

Although executive functioning is considered in a domain of general cognitive function which includes working memory, inhibitory control, cognitive flexibility, set shifting, attention, planning, and initiation (e.g., Denckla & Reiss, 1997; Zelazo, Carter, Reznick, & Frye, 1997), recently, researchers have argued that EF is comprised of two distinct dimensions, an emotional component of EF (which is called "hot" EF) and a cognitive component of EF (which is called "cool" EF) (Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Hongwanishkul, Happaney, Lee, & Zelazo, 2005; Zelazo & Muller, 2002). Hot EF is thought to be related to emotion regulation such as delay gratification and capacities to down regulate emotional responses whereas cool EF is presumed to be related to cognitive regulation such as effortful control and to plan/organize (Brock et al., 2009). Therefore, it is suggested that the unique features of two EFs may differentially predict different facets of developmental outcomes (Hongwanishkul et al., 2005). For example, cool EF may be closely associated with academic achievements whereas hot EF may be related to emotional outcomes. However, empirical findings have shown that this is not the case. Preschool and kindergarten children who had high "hot" EF showed higher academic achievements than children with who had low "hot" EF (Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003). In addition, Hongwanishukul et al. (2005) found that cool EF was associated with temperament but hot EF was not related to child temperament. These findings highlight the complex nature of the relations between emotion and cognition.

In the current study, although children's perceptual asymmetry was related to negative affect expression and initiations, children's global composite scores of executive functioning were a unique and significant predictor of children's negative affect expression and initiations

over and beyond child age, gender, and language ability. Importantly, children's general composite scores of executive functioning included both hot EF and cool EF. These findings suggest that children's tendencies to express negative emotions and initiations can be especially influenced by children's higher-order general cognitive abilities to regulate their emotions, cognitions, and behaviors and to plan/organize problem solving (both cool and hot EF).In addition, flexibility (a subscale of the BRIEF-P assessing executive functioning) was the only variable that was significantly associated with positive initiations among peers, such that children who have difficulty regulating and shifting their behaviors and emotions when they experience new stimuli were significantly *less* likely to initiate (not just express positive emotion) positive social interactions with their friends. Indeed, flexibility can be referred to as a hot EF ability reflecting the emotional component of EF. This finding suggests that children's abilities to initiate positive social interactions may be influenced by children's hot EF which involves regulating and shifting behaviors and emotions in response to new stimuli.

Overall, these results highlight the importance of the interconnectedness between emotion and cognition and especially for our understanding of children's negative affect expression and social interactions during preschool period. In addition, this finding supports the argument that emotion and cognition are intricately associated with the execution of behavior (Bell & Wolfe, 2004; Gray et al., 2002; Pessoa, 2008; Wolfe & Bell, 2009). Importantly, this finding also supports the notion that regulatory aspects of development can be closely related one another (Bell & Wolfe, 2004; Cacioppo & Berntson, 1999; Cole et al., 2004) because higher-order cognitive regulatory abilities of children were a unique predictor of their expression of negative affect.

These data may also have implications for the study of emotion and cognition in

children's psychopathology (Nigg et al., 2002). Children with autism or Attention Deficit Hyperactivity Disorder (ADHD) have been found to have deficits in both executive functioning and emotion regulation (see Barkley, 1997; Hill, 2004; Lambek et al., 2010). Moreover, Zelazo and Muller (2002) suggested that autism and ADHD are differentially associated with cool and hot EF. Autism may be a main disorder of hot EF with subordinate deficits in cool EF (e.g., Dawson, Meltzoff, Osterling, & Rinaldi, 1998) whereas ADHD may be an original disorder of cool EF with secondary deficits in hot EF (e.g., Dinn, Robbins, & Harris, 2001). The data from this study show that children's cognitive and emotional regulatory strategies affect their experience of emotion (negatively valenced) as well as their tendency to initiate negative behavior in their everyday interactions among peers. Thus, children's general cognitive abilities to regulate and shift their behaviors and emotions according to new environments and to plan/organize goals may be important factors especially for understanding negative affect expression and negative social initiations.

**Attachment Security, Perceptual Asymmetry, and Executive Functioning**

The purpose of this study was to examine the relations between three constructs in different areas of study that have been shown to affect children's emotion (i.e., attachment security, perceptual asymmetry in the processing of emotion, and executive functioning) and three different dimensions of children's emotion behavior (i.e., emotion recognition, emotion expression, and social initiations). Because these constructs cut across different areas of study, and based on theoretical relevance, the associations among attachment security, perceptual asymmetry, and executive functioning were also explored. The results revealed that attachment security, perceptual asymmetry, and executive functioning were *not* found to be significantly associated with one another. One of the reasons for non-significant associations among

attachment security, perceptual asymmetry, and executive functioning may be due to the methodology used to assess these three variables.

First, two story stems (e.g., spilled soup and hurt knee) from the MacArthur Doll-Story Stem Procedure (MSSB; Bretherton et al., 1990; Page & Bretherton, 2003) were used to examine children's attachment security in this study. In addition, five areas of the story process (avoidance, anxiety, story resolution, coherence, and security) were evaluated using the rating system developed by Bretherton and the MacArthur Narrative Workgroup (Oppenheim et al., 1997) for two story stems. However, attachment researchers have used different story stems and coding systems to assess young children's attachment relationships and representations for children. For example, Bretherton et al. (1990) used five story stems from an Attachment Story Completion Task (e.g., spilled juice, hurt knee, monster in bed, depart and reunion) and used "security" scores to assess children's attachment relationships. Laible (2006) used six story stems (from the original eleven story stems) from MSSB that were verbally the simplest. In addition, they evaluated 7 content themes adopted from the MacArthur Narrative Workgroup and used 2 content composite scores (e.g., a prosocial composite score and an aggressive composite score) that were derived from the 7 content themes and coherence score to assess attachment relationships. Oppenheim (1997) used six story stems which were related to the issue of separation and reunion and evaluated 3 scales (emotional openness, constructive resolution, and emotional tone). As such, the selection of story stems and coding systems may influence the assessment of children's attachment security and representations. Thus, it is suggested that future research should encompass various story stems and coding systems to better assess the nature of these relations.

In addition, different attachment measures such as Attachment Q-Sort (AQS) may be

more appropriate for detecting the associations among attachment relationships, perceptual asymmetry, and executive functioning. The AQS is thought to be a valid and reliable assessment tool for children's secure base behavior (Posada et al., 1995; Van IJzendoorn, Vereijken, Bakermans-Kranenberg, & Riksen-Walraven, 2004) and is thought to capture children's organization of behavior around their caregivers. Since executive functioning, as measured by the BRIEF-P, focuses on children's regulatory behaviors and emotions in everyday settings, and the AQS taps into secure base behaviors (many of them with emotion-related content), the scores for secure base behavior assessed by AQS may overlap more with executive functioning than attachment representations evaluated by the story completion task. Therefore, it is suggested that multiple measures which tap into different facets of attachment relationships should be included in future research in order to show the associations between cognition and emotion and how they influence children's emotional development.

The Chimeric Face Task (CFT) was used as a neural proxy for the processing of emotion especially for the identification of emotional information. In this study, we used only pictures of happiness to assess children's perceptual asymmetry. Including a wide range of emotional expression in CFT may offer a more complete picture of children's perceptual asymmetry and its relations to children's attachment and executive functioning. Although the CFT is a neural proxy for the perceptual processing of emotion, other neurobiological assessments of emotion processing, such as frontal EEG asymmetry using electroencephalographic (EEG) activation (e.g., Davidson, 1993, 1998; Tomarken, Davidson, Wheeler, & Doss, 1992) and functional magnetic imaging (fMRI) (Pessoa, 2010), have been shown to be significantly associated with attachment security (see Dawson et al., 2001; Gillath et al., 2005; Rognoni et al., 2008; Warren et al., 2010). It may be that different aspects of neural processing (such as perceptual asymmetry

specific to emotion identification and frontal EEG asymmetries specific to experience of emotion) are associated with relational experiences in different ways. Thus, multiple measurements should be used to better understand the neural correlates of emotion processing in young children.

Children's executive functioning was assessed using the Behavioral Rating Inventory of the Executive Functioning-Preschool Version (BRIEF-P; Gioia et al., 2003) rated by head teachers of the children. The BRIEF-P is the first standardized scale which assesses children's executive functioning based on parent's or teacher's observations of the daily lives of children (Isquith et al., 2005). In this study, head teachers of the children evaluated children's executive functioning when the semester ended. However, multiple observers' information may capture children's executive functioning more completely than a single observer's report. Thus, a multi-informant approach should be used in future studies to better understand children's executive functioning, and the relations between children's executive functioning and developmental outcomes.

A multi-method approach is also recommended. For example, it would be interesting to include measures of children's executive functioning that are typically used in experimental studies, such as a Self-Ordered Pointing task (see Gathercole, 1998, for a review), DCCS (e.g., Hongwanishkul et al., 2005; Zelazo et al., 2003), Iowa Gambling Task (e.g., Bechara, Damasio, Damasio, & Anderson, 1994), and Delay Discounting (e.g., Green, Myerson, & Ostaszewski, 1999) to document the degree to which these measures and teacher reports are associated and perhaps differentially tap into more relational and neurobiological contributors to emotion outcomes. Because experimental measures of EF are thought to tap into different aspects of EF (Anderson, Anderson, Northam, Jacobs, & Mikiewicz, 2002; Rasmussen, McAuley, & Anderew, 2007), multiple methods of EF may embrace broad aspects of EF.

In addition to measurement issues, another reason for the non-significant associations among attachment security, perceptual asymmetry, and executive functioning found in this data is that they may reflect rather separate constructs in different domains of children's development that contribute to their emotion recognition and expression. Indeed, the data from this study show that children's attachment security, perceptual asymmetry (to a much less extent), and executive functioning may have considerable impact on children's developing capacities to recognize and experience different emotions. These data are important because they capture constructs across developmental domains and because they include different dimensions of emotion functioning (recognition and expression). Furthermore, documenting these associations using observational assessments of children's emotional expression and social initiations during daily interactions in the classroom is a contribution to the literature.

**The Interactive Effects of Attachment Security and Executive Functioning on Children's Emotion Recognition and Positive Affect Expression**

The findings from this study revealed significant interaction effects of attachment security (measured in story completion task) and flexibility (executive functioning subscale based on teacher's rating) on children's positive affect expression during early childhood. Based on a non-clinical sample of preschool children, this study revealed that inflexibility reflected in the BRIEF-P was related to children's difficulty expressing positive emotions in the classroom particularly when children were insecure whereas secure children were observed expressing positive emotions more frequently than were insecure children whether or not they had difficulty regulating and shifting their behaviors and emotions according to new environments or people. Thus, inflexibility in the BRIEF-P may be a risk factor in emotion functioning especially for children who are insecure, and security may act as a "buffer" against the deleterious effects of

inflexibility on emotion outcomes.

These data also suggest that children's flexibility may be important to consider when demarcating avoidant and ambivalent patterns of attachment. Specifically, we found that insecure children who had high flexibility (i.e., had more difficulty shifting cognitive and emotional demands according to new environments) were more likely to be anxious and less likely to be avoidant than insecure children who had low flexibility. These children, in turn, may have to put more cognitive effort into continuously monitoring emotions and behaviors in close relationships (see Kobak et al., 1993; Shaver & Mikulincer, 2010). In contrast, insecure children who had less difficulty in flexibility were more likely to be categorized as avoidant. Avoidant children typically develop deactivating emotional strategies such as being insensitive to emotional cues and not openly expressing their emotions (see Kobak et al., 1993; Shaver & Mikulincer, 2010). These data, in part, support these emotion-cognition inferences in attachment theory, and highlight the need to further examine the cognition-emotion interplay in attachment relations (see Atkinson et al., 2009; Edelstein & Gillath, 2008; Zeijlmans van Emmichoven et al., 2003).

It is important to note that flexibility, which can be considered as an emotional component of executive functioning (hot EF) was related to insecure attachment patterns and influenced children's positive affect expression for insecure children. Although the items that constitute the flexibility subscale from the BRIEF-P appear to be similar to emotional reactivity items in assessments of child temperament (Posner & Rothbart, 1998), flexibility is thought to be distinct from child temperament. This is because hot EF is a *volitional* regulatory process of cognition and emotion whereas emotion reactivity or effortful control is an *automatic /nonconscious* regulatory process of emotion which is biologically rooted and therefore difficult to change (see Blair & Razza, 2007; Botvinick, Braver, Barch, Carter, & Cohen, 2001).

Empirical findings have also supported the notion that executive functioning can be differentiated from child temperament. For example, children's hot EF has been found to develop during the preschool period and is closely related to other cognitive components of EF (e.g., Zelazo & Muller, 2002; Hongwanishkul et al., 2005). In addition, some researchers have found only moderate relations between executive functioning and effortful control (Carlson & Moses, 2001; Davis, Bruce, & Gunnar, 2002; Rothbart, Ellis, Rueda, & Posnar, 2003) whereas other researchers report no significant associations between hot EF and temperament for preschool children (Hongwanishkul et al., 2005). In this literature, children's flexibility (hot EF) is viewed as a higher-order cognitive and emotional capacity to regulate and adjust behaviors and emotions to new stimuli. Future studies that include both EF and temperament assessments are needed to tease apart these associations.

**The Effects of Age, Gender, Language Ability on Emotion Processing**

In the current study, the effects of child age, gender and language ability on children's emotion recognition, emotion expression, and the initiations of social interaction were investigated. Child age was closely related to all aspects of emotion processing in the current study. Older children were more likely to recognize different emotions and to express positive emotions than younger children. In contrast, younger children were more likely to express negative emotions and to initiate negative interactions as well as to initiate positive interactions. This is consistent with previous research that children's emotion understanding develops during childhood (for reviews, see Harris, 2000; Saarni, Mumme & Campos, 1998).

In terms of gender differences in emotion processing, this study found that boys were significantly more likely to express negative emotions and initiate negative interactions than were girls whereas girls were significantly more likely to express positive emotions than were

boys. These results are also consistent with the literature on gender differences in children's emotion expression suggesting that girls are less likely to show anger than are boys (see Brody, 1999; Saarni, 1984). Researchers in this area have argued that girls are more likely to express submissive emotions (sadness and anxiety) than boys in order to receive care and comfort from others whereas boys are more likely to express disharmonious emotions (anger) to achieve their goals (Barrett & Campos, 1987; Campos, Mumme, Kermoian, & Campos, 1994; Chaplin, Cole & Zahn-Waxler, 2005; Izard & Ackerman, 2000).

Finally, child's language ability was examined with study variables. Although there was no direct assessment of children's language ability, we used narrative length from the birthday party warm-up story in the doll play. The results revealed that narrative length was related to individual differences in emotion processing, attachment security and executive functioning. Specifically, children who talked more in a warming up story (happy birthday story) were more likely to recognize different emotions and to express positive emotions than children who talked less in a warming up story. This is consistent with previous research findings showing that children's language abilities are related to the understanding of emotion (Cutting & Dunn, 1999; De Rosnay & Harris, 2002; Pons, Lawson, Harris, & De Rosnay, 2003) and emotion regulation (Cohen & Mendez, 2009). In addition, children who talked more in warming up story were more likely to be securely attached than children who talked less in a warming up story. Since attachment security was assessed by a story completion task which was related to child's expressive language, it was not surprising that child's language ability was related to children's attachment security. Taken together, the results of this study regarding child age, gender, and language ability effects on emotion outcomes were consistent with normative developmental expectations. By taking into account these covariates in all the relevant analyses, we documented

how attachment security, perceptual asymmetry, and executive functioning uniquely and jointly influenced preschool children's emotion recognition and expression above and beyond the effects of child age, gender, and language ability.

## Chapter Six: Conclusion and Limitations

Although this study contributes to our understanding of the multifaceted nature of emotions in early childhood by integrating relational, cognitive, and neurobiological approaches, there were several limitations in this study. First, participants in this study were predominantly middle class so the sample was not representative. Thus, future studies should include children who have a wide range of socioeconomic backgrounds.

Second, this study is cross-sectional and not longitudinal, so it's difficult to document casual relations. Thus, alternative models were tested whether or not emotion variables significantly predicted attachment and EF variables. Emotion recognition was *not* a significant predictor of attachment security and negative affect expression and initiations was *not* a significant predictor of emergent metacognition. However, other emotion variables significantly predicted attachment security, inhibitory self-control, flexibility, and global executive composite (e.g., positive affect expression predicted attachment security and positive social initiations predicted flexibility). Although bi-directional and transactional effects are theoretically expected, longitudinal data are needed to show the causal direction of these effects.

Third, this study investigated emotion recognition, expression of affect, and social initiations as emotional outcomes. Given that there are different dimensions of emotion organization such as understanding, experiences, and regulation of emotions, future studies should include more direct assessments of emotion regulation for a better understanding of the associations among the regulatory aspects of emotional, cognitive, and behavioral development.

Fourth, as previously mentioned, the items of flexibility subscale in the current study were similar to assessments of child temperament. Vaughn, Bost, and Van IJzendoorn (2008) recommended that both attachment and temperament measures should be included in studies

which investigate children's emotional and social development because previous findings have documented direct and indirect effects of both on children's social and emotional development. Based on these reasons, future studies should include child temperament measures to examine how child temperament is related to executive functioning, attachment security, and perceptual asymmetry and to investigate the combined effects of temperament and other variables on different aspects of emotion processing.

Fifth, although this study examined three different domains as independent variables, we used only one assessment tool for each (e.g., attachment security was assessed by MSSB and perceptual asymmetry was examined using the CFT). The AQS scores reflect the behavioral aspects of attachment security (Waters & Cummings, 2000) and frontal EEG asymmetry has been shown to be related to attachment security (e.g., Dawson et al., 2001; Rognoni et al., 2008). Thus, future studies should include multiple measurements of each domain to better understand the nature of these relations.

Sixth, this study is limited because of the small sample size and the missing data (e.g., 26.15 % of emotion expression was missing). However, multiple imputations were used to deal with missing data to cover this limitation. Multiple imputations are known as a useful statistical method for treating missing data because multiple imputations provide multiple simulated values and thus cover data uncertainty and a finite sample variation (e.g., Schafer & Graham, 2002). As anticipated, the results of this study were consistent with theory and previous findings. Thus, multiple imputations increase the robustness of our findings.

Despite the limitations of this study, the findings contribute to the study of children's organization and development of emotion in several ways. First, this is one of few studies that have examined the associations among attachment security, perceptual asymmetry, and executive

functioning. Although previous research has documented the relations between perceptual asymmetry and emotion recognition (e.g., Levine & Levy, 1986; Levy et al., 1983; Waitling & Bourne, 2007; Workman et al., 2006), between executive functioning and socio-emotional competence (e.g., Brophy et al., 2002; Hughes et al, 2000; Riggs et al., 2006), between attachment and emotion processing (e.g., Sroufe, 1996; Sroufe et al., 1984; Kerns et al., 2007; Thompson & Goodvin, 2005), there has been virtually no empirical data which investigates the combined effects of relevant relational, neurobiological and cognitive capacities on different aspects of emotion processing.

In addition, this study investigated different aspects of emotions which include decoding aspects of emotion (recognition) and experience of emotion (emotion expression and initiations of social interaction). This allowed for more fine-tuned examinations of the influences of attachment and EF on emotion outcomes. For example, the data showed that global EF was especially important in the expression and initiations of negative affect; attachment was most predictive of the expression of positive affect; and EF was significantly associated with emotion recognition. Furthermore, it allowed for the examination of the associations among different emotion outcomes that were based on child interviews and observations. For example, children's recognition of different emotions was highly correlated with their expression of positive affect in the classroom.

Third, these data are noteworthy because they document interaction effects of attachment security and executive functioning on emotion recognition and positive affect expression. This highlights the interconnectedness between emotion and cognition for understanding children's emotion processing in early childhood. Importantly, the emotional component of executive functioning (hot EF) may be helpful in examining how different attachment patterns may

influence children's emotional strategies especially when children are insecure.

Fourth, compared to the extant literature which examines how early experiences influence neurobiological mechanisms of emotion that generally focus on the actual experience of emotions (e.g., Dawson et al., 2001; Rognoni et al., 2008), this study explored the associations between attachment security and perceptual asymmetry which reflected the neurobiological processes of decoding emotions. Although significant relations were not found in the current study, this study is still noteworthy because it provides preliminary data suggesting that the right hemisphere advantage is developing in preschool years and that it may be useful to examine individual differences in this lateralization across the preschool years.

Finally, the findings contribute to the attachment literature by focusing on how attachment security may facilitate children's experiences of positive emotion (but not necessarily diminish negative emotions) in everyday interactions with peers. Thus, attachment is not only important in situations when there is a need to regulate/resolve negative experiences (or distress), but also in the capacity to embrace positive experiences (e.g., Bowlby, 1973, 1980; Cassidy, 1994; Laible & Thompson, 1998; Sroufe, 1996). This is important because data in the positive psychology tradition show that the frequency of positive emotions is a crucial predictor of happiness or affective well-being which is related to resiliency (Diener et al., 2009).

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## Tables and Figure

Table 1

*Descriptive Statistics for All Variables (Before Data Imputations)*

| | Mean | SD | Min | Max |
|---|---|---|---|---|
| Avoidance | 2.47 | 0.88 | 1.00 | 4.25 |
| Anxiety | 2.54 | 0.79 | 1.00 | 4.00 |
| Story Resolution | 2.18 | 0.72 | 0.75 | 3.00 |
| Coherence | 4.45 | 1.17 | 2.50 | 6.50 |
| Security | 4.28 | 1.18 | 2.00 | 6.50 |
| Perceptual Asymmetry | -.07 | .24 | -.56 | .56 |
| Inhibitory Self-Control | 39.40 | 12.74 | 26.00 | 68.00 |
| Flexibility | 29.38 | 8.32 | 20.00 | 56.00 |
| Emergent Metacognition | 34.78 | 10.25 | 27.00 | 73.00 |
| Global Executive Composite | 89.84 | 24.17 | 63.00 | 155.00 |
| Language Skill | 44.88 | 31.99 | 2.00 | 151.00 |
| Emotion Recognition | 3.44 | 1.38 | 1.00 | 6.00 |
| Positive Affect Expression | .69 | .17 | .30 | .96 |
| Neutral Affect Expression | .25 | .16 | .02 | .62 |
| Negative Affect Expression | .06 | .05 | .00 | .27 |
| Positive Social Initiations | .41 | .24 | .00 | 1.00 |
| Neutral Social Initiations | .11 | .13 | .00 | .81 |
| Negative Social Initiations | .05 | .06 | .00 | .28 |

*Note*. $48 < N < 65$

Table 2

*Descriptive Statistics for All Variables (After Data Imputations)*

| | Mean | SD | Min | Max |
|---|---|---|---|---|
| Avoidance | 2.45 | 0.86 | 1.00 | 4.25 |
| Anxiety | 2.55 | 0.79 | 1.00 | 4.00 |
| Story Resolution | 2.19 | 0.70 | 0.75 | 3.00 |
| Coherence | 4.43 | 1.14 | 2.50 | 6.50 |
| Security | 4.27 | 1.16 | 2.00 | 6.50 |
| Perceptual Asymmetry | -.07 | .24 | -.56 | .56 |
| Inhibitory Self-Control | 39.84 | 12.85 | 26.00 | 68.00 |
| Flexibility | 29.85 | 8.45 | 19.67 | 56.00 |
| Emergent Metacognition | 35.12 | 10.00 | 27.00 | 73.00 |
| Global Executive Composite | 90.07 | 23.49 | 63.00 | 155.00 |
| Language Skill | 45.21 | 31.49 | 2.00 | 151.00 |
| Emotion recognition | 3.45 | 1.37 | 1.00 | 6.00 |
| Positive Affect Expression | .73 | .18 | .30 | 1.00 |
| Neutral Affect Expression | .22 | .16 | .02 | .62 |
| Negative Affect Expression | .05 | .05 | .00 | .27 |
| Positive Social Initiations | .41 | .24 | .00 | 1.00 |
| Neutral Social Initiations | .11 | .13 | .00 | .81 |
| Negative Social Initiations | .05 | .06 | .00 | .28 |

*Note*. N = 65

Table 3

*Component Loadings of Story Completion Task (Before and After Data Imputations)*

| | Attachment Security (Before Imputations) | Attachment Security (After Imputations) |
|---|---|---|
| Avoidance | **-.79** | **-.80** |
| Anxiety | -.57 | -.57 |
| Story Resolution | **.93** | **.93** |
| Coherence | **.97** | **.97** |
| Security | **.97** | **.97** |
| % of Variance | 74.14 | 74.13 |

Table 4-1

*Component Loadings of Emotion Expression and Social Initiations (Before Data Imputations)*

| | Positive Affect Expression | Neutral Social Initiations | Negative Affect Expression/Initiations |
|---|---|---|---|
| Positive Affect Expression | **.97** | .13 | -.18 |
| Neutral Affect Expression | **-.98** | -.12 | -.08 |
| Negative Affect Expression | -.24 | -.05 | **.83** |
| Positive Social Initiations | .01 | **-.88** | -.20 |
| Neutral Social Initiations | .25 | **.82** | -.07 |
| Negative Social Initiations | .14 | .18 | **.85** |
| % of Variance | 33.86 | 24.96 | 24.72 |

Table 4-2

*Component Loadings of Emotion Expression and Social Interaction (After Data Imputations)*

| | Positive Affect Expression | Positive Social Initiations | Negative Affect Expression/Initiations |
|---|---|---|---|
| Positive Affect Expression | **.96** | -.16 | -.22 |
| Neutral Affect Expression | **-.98** | .15 | -.01 |
| Negative Affect Expression | -.26 | .09 | **.80** |
| Positive Social Initiations | -.02 | **.91** | -.10 |
| Neutral Social Initiations | .32 | **-.78** | -.12 |
| Negative Social Initiations | .07 | -.08 | **.89** |
| % of Variance | 34.16 | 25.21 | 24.82 |

Table 5

*Correlations Among All Study Variables (Before Data Imputations)*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Attachment Security | - | | | | | | | | | | |
| 2. Perceptual Asymmetry | -.02 | - | | | | | | | | | |
| 3. Inhibitory Self-Control | .11 | .19 | - | | | | | | | | |
| 4. Flexibility | .23 | .20 | .83*** | - | | | | | | | |
| 5. Emergent Metacognition | .08 | .06 | .77*** | .61*** | - | | | | | | |
| 6. Global Executive Composite | .14 | .12 | .94*** | .83*** | .92*** | - | | | | | |
| 7. Emotion Recognition | .28* | -.10 | .23+ | .35** | .15 | .26+ | - | | | | |
| 8. Positive Affect Expression | .39** | .04 | .16 | .27+ | .13 | .18 | .48*** | - | | | |
| 9. Neutral Social Initiations | .17 | -.04 | .28+ | .26+ | .30* | .32* | .20 | .00 | - | | |
| 10. Negative Affect Expression and Initiations | -.05 | .32* | .51*** | .53*** | .31* | .44** | -.22 | .00 | .00 | - | |
| 11. Children's Language Fluency | .24+ | .01 | .20 | .28* | .13 | .21 | .39** | .29+ | -.07 | .17 | - |

*Note*. 48 < N < 65 + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 6

*Correlations Among All Study Variables (After Data Imputations)*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Attachment Security | - | | | | | | | | | | |
| 2. Perceptual Asymmetry | -.01 | - | | | | | | | | | |
| 3. Inhibitory Self-Control | -.06 | .11 | - | | | | | | | | |
| 4. Flexibility | .06 | .06 | .84*** | - | | | | | | | |
| 5. Emergent Metacognition | .03 | .06 | .75*** | .59*** | - | | | | | | |
| 6. Global Executive Composite | .05 | .07 | .91*** | .80*** | .88*** | - | | | | | |
| 7. Emotion Recognition | .27* | -.11 | .31* | .44** | .19 | .31* | - | | | | |
| 8. Positive Affect Expression | .38** | .15 | .18 | .36** | .15 | .20 | .55*** | - | | | |
| 9. Positive Social Initiations | -.01 | .15 | -.18 | -.25* | -.06 | -.20 | -.15 | .00 | - | | |
| 10. Negative Affect Expression and Initiations | -.04 | .24+ | .50*** | .45*** | .33* | .43** | -.23+ | .00 | .00 | - | |
| 11. Children's language Fluency | .26* | .03 | .23 | .29* | .20 | .22 | .42** | .32** | .11 | .19 | - |

*Note.* N = 65 + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 7

*Partial Correlations Among Predictor Variables (Attachment, Perceptual Asymmetry, and Executive Functioning)*

| | Perceptual Asymmetry | Inhibitory Self-Control | Flexibility | Emergent Metacognition | Global Executive Functioning |
|---|---|---|---|---|---|
| Attachment Security | .01 | -.06 | -.02 | -.02 | -.01 |
| Perceptual Asymmetry | - | .13 | .08 | .03 | .06 |

*Note*. All correlations are partial correlations considering relevant covariates (i.e., child age, gender, and child language ability). For example, child language ability and child age were controlled for the association between attachment composite score and perceptual asymmetry. None of them are statistically significant.

Table 8

*Partial Correlations Among Outcome Variables (Emotion Recognition, Positive Affect Expression, and Positive Social Initiations)*

| | | Emotion Recognition | Positive Affect Expression | Positive Social Initiations |
|---|---|---|---|---|
| Positive Affect Expression | | **.36**** | - | - |
| Positive Social Initiations | | -.03 | .09 | - |
| Negative Affect Expression /Initiations | | -.16 | .16 | -.14 |

*Note*. All correlations are partial correlations considering relevant covariates (i.e., child age, gender, and child language ability). ** $p < .01$.

Table 9

*Correlations Among Attachment and Emotion Variables*

| | Emotion Recognition | Positive Affect Expression | Positive Social Initiations | Negative Affect Expression/Initiations |
|---|---|---|---|---|
| Attachment | **.27*** | **.38**** | -.01 | -.04 |

*Note*. N = 65 + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 10

*Partial Correlations Among Attachment Security and Emotion Variables*

| | Emotion Recognition | Positive Affect Expression | Positive Social Initiations | Negative Affect Expression/Initiations |
|---|---|---|---|---|
| Attachment | .15 | **.29*** | -.01 | .01 |

*Note*. N = 65 + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. All correlations are partial correlations considering relevant covariates (i.e., child age, gender, and child language ability).

Table 11

*Descriptive Statistics for All Variables by Attachment Patterns in Doll Play*

| | Children who were categorized as Avoidant (N=31) | | Children who were categorized as Anxious (N=34) | | t |
|---|---|---|---|---|---|
| | M | SD | M | SD | |
| Emotion Recognition | 2.98 | 1.06 | 3.88 | 1.49 | -2.79** |
| Positive Affect Expression | -.27 | .99 | .25 | .96 | -2.18* |
| Positive Social Initiations | .19 | .97 | -.17 | 1.01 | 1.44 |
| Negative Affect Expression and Initiations | .00 | 1.07 | .00 | .94 | -.02 |
| Attachment Security | -.02 | 1.04 | .02 | .98 | -.14 |
| Perceptual Asymmetry | -.09 | .27 | -.06 | .22 | -.64 |
| Inhibitory Self-Control | 36.73 | 10.32 | 42.67 | 13.88 | -1.94+ |
| Flexibility | 27.58 | 6.43 | 31.92 | 9.57 | -2.12* |
| Emergent Metacognition | 35.12 | 9.77 | 35.12 | 10.34 | 0 |
| Global Executive Composite | 87.68 | 20.44 | 92.26 | 26.08 | -.78 |
| Language Ability | 36.54 | 27.20 | 53.12 | 33.40 | -2.18* |

*Note*. N = 65 + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 12

*Correlations Among Perceptual Asymmetry, Executive Functioning, and Emotion Variables*

| | Emotion Recognition | Positive Affect Expression | Positive Social Initiations | Negative Affect Expression/Initiations |
|---|---|---|---|---|
| Perceptual Asymmetry | -.11 | .15 | .15 | .24+ |
| Inhibitory Self-Control | .31* | .18 | -.18 | .50*** |
| Flexibility | .44** | .36** | -.25* | .45*** |
| Emergent Metacognition | .19 | .15 | -.06 | .33** |
| Global Executive Functioning | .31* | .20 | -.20 | .43*** |

*Note*. N = 65 + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 13

*Partial Correlations Between Perceptual Asymmetry, Executive Functioning, and Emotion Variables*

| | Emotion Recognition | Positive Affect Expression | Positive Social Initiations | Negative Affect Expression/Initiations |
|---|---|---|---|---|
| Perceptual Asymmetry | .03 | .25+ | .08 | .21+ |
| Inhibitory Self-Control | .40** | .24+ | -.29* | .41** |
| Flexibility | .37** | .32* | -.27* | .47*** |
| Emergent Metacognition | .28** | .21 | -.14 | .21 |
| Global Executive Functioning | .37** | .22+ | -.27* | .36*** |

*Note*. N = 65 + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 14

*Results of Hierarchical Multiple Regressions Predicting Emotion Recognition*

| | Emotion Recognition | | | |
|---|---|---|---|---|
| | $\beta$ | $F$ change | $\Delta R^2$ | Total $R^2$ |
| *Step 1* | | 28.29** | .48** | |
| Child age | .56 ** | | | |
| Child's language ability | .34** | | | |
| *Step 2* | | 5.73** | .08** | .56** |
| Child age | .57** | | | |
| Child's language ability | .25* | | | |
| Attachment security | .11 | | | |
| Global Executive Functioning | .28** | | | |
| *Step 3* | | 2.59 | .02 | .58 |
| Child age | .55** | | | |
| Child language ability | .24* | | | |
| Attachment Security | .12 | | | |
| Global Executive Functioning | .29** | | | |
| Attachment × Flexibility | -.13 | | | |

* $p < .05$, ** $p < .01$

Table 15

*Results of Hierarchical Multiple Regressions Predicting Positive Affect Expression*

| | Positive Affect Expression | | | |
|---|---|---|---|---|
| | $\beta$ | $F$ change | $\Delta R^2$ | Total $R^2$ |
| *Step 1* | | 8.26** | .22** | |
| Child age | .35 ** | | | |
| Child's language ability | .27* | | | |
| *Step 2* | | 6.17** | .13** | .35** |
| Child age | .28** | | | |
| Child's language ability | .13 | | | |
| Attachment security | .29** | | | |
| Flexibility | .26 | | | |
| *Step 3* | | 4.35* | .05* | .40* |
| Child age | .24* | | | |
| Child language ability | .13 | | | |
| Attachment Security | .27* | | | |
| Flexibility | .31** | | | |
| Attachment × Flexibility | -.23* | | | |

* $p$ <.05, ** $p$ < .01

Table 16

*Regression Models Predicting Attachment Security and Executive Function Variables*

| | Outcome | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Attachment | | Inhibitory Self-Control | | Flexibility | | | | EM | Global Executive Composite | |
| | Model 1: ER | Model 2: PA | Model 3:ER | Model 4: NA/I | Model 5: ER | Model 6: PA | Model 7: PI | Model 8: NA | Model 9: NA/I | Model 10: ER | Model 11:NA/I |
| Emotion Recognition | .15 | | 4.68** | | 3.03** | | | | | 8.55** | |
| Positive Affect Expression | | .33* | | | | 2.41* | | | | | |
| Positive Social Initiations | | | | | | | -2.29* | | | | |
| Negative Affect Expression /Initiations | | | | 5.56** | | | | 4.36*** | 2.33 | | 9.5** |
| Child Age | .00 | .00 | -.39* | .13 | -.13 | .02 | .03 | .28** | -.03 | -.82* | .23 |
| Language Ability | .01 | .01 | .03 | .06 | .03 | .05 | .09* | .04 | .05 | .04 | .10 |
| Gender | | | -8.13** | -4.74 | | | | -1.34 | -2.88 | | -4.47 |
| *Model* $R^2$ | .10+ | .17* | .30*** | .30*** | .23** | .16* | .16* | .35*** | .15* | .18** | .22* |

*Note*. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. ER=Emotion Recognition, PA=Positive Affect Expression, PI=Positive Social Initiations, NA/I=Negative Affect Expression and Initiations

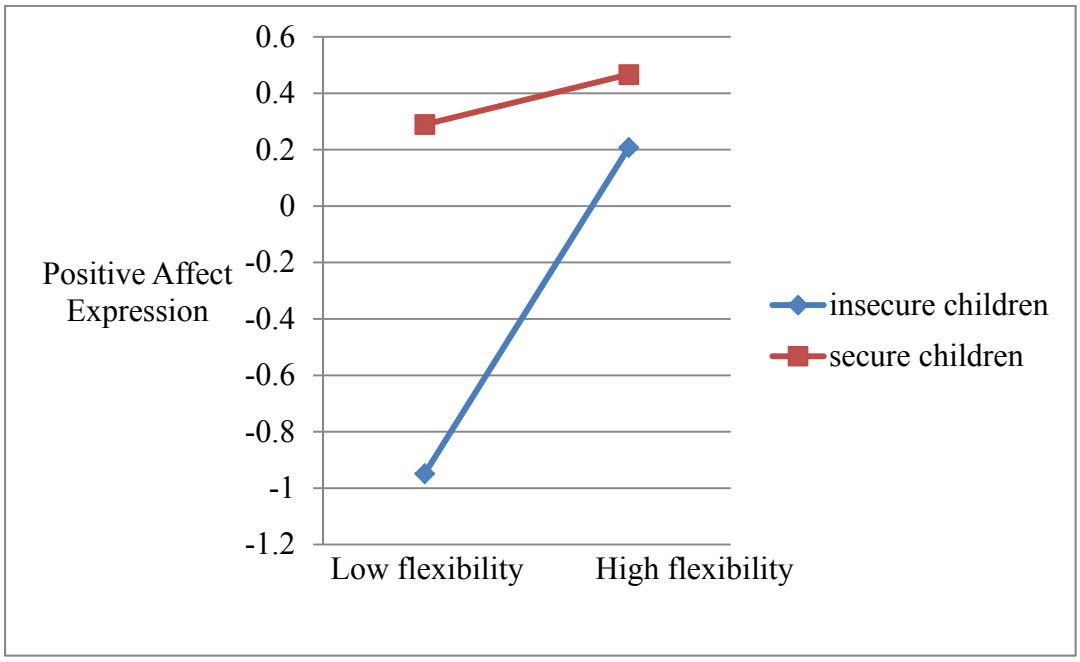


*Figure 1*.
Association between children's positive affect expression and flexibility for insecure and secure children.

**Appendix A: Summary of Two Story-Stems Used in Story Completion Task**

| Story Stem | Family Members Involved | Description |
|---|---|---|
| Spilled soup | Mother, father, child, sibling, grandmother | His/her mother tells the child not touch a hot soup. However, the child touches the hot soup, spills it, and burns his/her hand. |
| Hurt knee | Mother, father, child, sibling, grandmother | When parents and grandmother go to neighborhood, they tell the child not to touch anything on the bathroom shelf. While they are gone, the child's sibling hurts his/her knee and needs a Band-aid, but Band-aids are on the bathroom shelf. |

## Appendix B:
## Coding System from MacArthur Story Stem Battery's Narrative Coding Manual (Bretherton, Oppenheim, Buchsbaum, Emde, & MacArthur Narrative Group, 1990)

### Avoidance (1-5)

Avoidance refers to the subject's reluctance to deal with the issue presented in the story or the entire task. Mild avoidance is regarded as an expectable response to stress and is considered adaptive provided that it does not ultimately interfere with the subject's ability to respond to the central conflict or issue presented in the story. Behavior that may appear to be avoidant but occurs at the end of a story response should be considered as avoidant only if the child appears to be shifting attention as a result of a highly emotional topic that may have been introduced in the story elaboration. If the child has given a full response to the story, and shifts focus at the end of a story (digresses), this should not be coded as avoidance. Coding avoidance requires an evaluation of the extent to which the subject is responding to the central problem contained in the story stem.

**1) No avoidance:** The child *immediately* responds to the central problem in a *positive* way. There is no hesitation. If "I don't know" or "no response" was the first response, do not code this as no avoidance.

**2) Mild avoidance:** Mild avoidance refers to situations in which the subject initially hesitates in dealing the central issue of the story but then proceeds to deal with it. Include as mild avoidance stories in which the subject says "I don't know" once or twice before providing a resolution to the story conflict. Or the subject says "no, nothing happens" or shrugs his shoulders or looks away when asked what happens or brings up irrelevant topic (such as talking about a figure's clothes) before dealing with the problem of the story and providing a resolution (generally minimal). Or asks the interviewer what happens before providing a resolution.

**3) Moderate avoidance:** The subject may acknowledge the central problem but then does not deal directly with it.Instead the subject may provide a modification of the story. Or a resolution is provided for the secondary problem only. Or there may be more than 3 incidents of ignoring, distracting or "I don't know" before telling at least a minimal resolution. Or the child walks away or asks the interviewer for another story before providing a resolution. Or child shows mixed responses (for exclusion story, initially showing obedience, and then come back without parental request).

**4) Pervasive avoidance:** Pervasive Avoidance is defined as a lack of attention to the central story problem. The child does not provide even a minimal resolution to the problem. In order to make a judgment about pervasive avoidance, the coder must have a good understanding of the problem resolutions demanded by each of the story stems. Check the listing of the expected responses to the central story problems that is required for a minimal resolution. (Under story resolutions). Do not code as avoidant stories which have no resolution but are very fragmented and not to the point. Such presentations (in which the stories are very bizarre, disjointed, with aimless aggression or elaborate rambling action or escalation of loss or hurt) are generally ambivalent rather than avoidant.

**5) Severe avoidance:** The severe avoidance code is used when the subject makes not even a minimal attempt to resolve the central conflict presented by the story. And in addition the subject clearly and explicitly denies the central issue/conflict of the story. For example, when he

or she insists that the children are going along on the trip or that the child is not hurt. Or the subject makes no response to the stem. Or just provides simple aimless movement of figures instead of a meaningful drama. Or the child walks away from the table or hides under the table or asks to leave or says that the story is ended - and no resolution has been provided.

**Anxiety/Ambivalence (1-5)**

Anxiety refers to a sense of worry, apprehension, fear and distress in a response with the story or the entire task. Negative affect is predominant for these children who display maladaptive ambivalence. These children exhibit ambivalence regarding both how to resolve the main issue and regarding their attachment figure. This ambivalence may be reflected in disorganized behaviors such as sequential of conflicting events. Exaggerated displays or affect may not be easily terminated and their distress may continue to escalate throughout the story. Such extreme displays of affect may lead the children to be too distraught to effectively communicate anything specific regarding the cause of their distress.

1**) No anxiety/ambivalence/resistance**

**2) Mild anxiety/ambivalence/resistance**: Mild anxiety refers to situations in which the subject shows mild distress in dealing the central issue of the story. Primarily neutral facial expression. The main issue may be immediately acknowledged, and a resolution (Either minimal or complete resolution) may be provided eventually. However, children may show some digression to relevant material or mild contradictions, shifts, or gaps before he/she resolves the problem.

**3) Moderate anxiety/ambivalence/resistance**: The subject's first reaction may be inappropriate (e.g., smile when a fearful/distressful situation was given). Children may show a mixed emotions (anxious->happy->anxious). A minimal resolution may be given after several prompts. There may be a series of bizarre, disjointed or aggressive digression to relieve their anxiety. However, the degree of bizarre or disjointed or aggression is not severe. There are moments that subject appears anxious, and there are moments that subject appears relaxed.

**4) Pervasive anxiety/ambivalence/resistance:** Story may be unresolved or have a very minimal resolution with a twist or a resolution for the secondary problem only. No resolution of the main issue presented in the story. Child shows a sense of apprehensions by displaying startle when presented with a stressful situation. The subject may display distress, and it may continue to escalate throughout the story. There may be bizarre, violent themes, disconnected, unreasonable action. Child may display aggressive behavior toward parents or objects.

5**) Severe anxiety/ambivalence/resistance**: Unresolved story that is not logical or understandable. There is a series of negative, disjointed or bizarre events. He/she may be hyperactive or aimlessly drifts from object to object. The subject tends to display "maladaptive behavior" to deal with the central issue. The subject may display anger (or aggression) to alert attachment figure to the presence of a problem and to their responsibility for resolving it (But no effective resolution was given by attachment figure). Child may be overwhelmed by negative emotions, too distraught to effectively communicate. Child may display some coping behavior (e.g., thumb sucking or a series of meaningless behavior).

**Story Resolution (1-3)**

**1) Unresolved**: The story is considered unresolved if the problem presented in the story stem is not addressed and taken care of. In other words there is not even a minimal resolution. Examples: Spilled soup: No one takes care of the hurt.

**2) Minimal resolution**: A minimal resolution code is given if the problem presented in the story stem is acknowledged and resolved, but minimally so. There is little or no elaboration to the resolution.

**3) Complete resolution**: A complete resolution code is given when in addition to the minimal expected resolution of the central problem of the story there is further elaboration and/or resolution of a secondary problem. Following is a list of the guidelines for coding minimal and complete resolution for each story issue.
2 = minimal resolution and 3 = complete resolution.
A complete resolution is comprehensive and includes meeting the requirements for a minimal resolution.

Soup:
2. The hurt hand is taken care of the parent, grandma, doctor, sibling, child or subject
3. The spilled soup is cleaned up and/or some more soup is made. The child may receive some nonphysical punishment
Hurt Knee
2. Hurt is attended to by someone
3. Parents are told what happened when they return

**Coherency (1-8)**

1**) Extreme incoherent**: There is no unified story, no plot, just series of severely disjointed events. Story is not logical. Frequent unexplained shifts, unconnected action. There is very little in the jumble of events that is related to the stem. Story is very difficult to understand. There may be odd stylized movements.

**2) Very incoherent**: The subject presents a very incoherent narrative. The incoherent category has 2 subcategories:

***2a) Severe avoidance***: No response or several "I don't knows" or "no" (nothing happens). No resolution. There is no story. The presentation may consist mainly of silent apparently meaningless movement of figures.

***2b) No logical story or resolution***. Simply sequence of severe negative or bizarre events.

**3) More incoherent**: This category may be subdivided onto 3 divisions:

***3a)*** The subject shows an understanding of the story stem but does not offer any resolution when the resolution is expected (perhaps in spite of specific or repeated general prompting). The subject may simply repeat the story stem. Or the subject may briefly start to deal with the problem then suddenly stop. This category would include unresolved that are not severely avoidant.

***3b)*** There is no resolution, nor any attempt to deal with the problem. Instead the story is bizarre disjointed, or aimless aggression or rambling action or escalation of loss or hurt. No real unified plot, rather series of disconnected actions. Fragments and not to the point.
3c) appropriate story resolution that show some coherence but with negative, bizarre digression

or pervasive aggression or lack of clarity. This category is related to "incoherent/a" but more severe. Sequence of aggressive, bizarre actions, lack of clarity, connection, logic. Or very negative, bizarre, aggressive story that is unresolved but has some connection to action.

**4) Incoherent**: The subject does not provide a coherent story. There may be occasional positive aspects of coherence but overall the story does not provide an appropriate resolution to the problem in a flowing, consistent, relevant, understandable manner. There may be several sources of incoherence.

***4a)*** The subject presents a story having a resolution with a twist. The child begins a story fairly coherently, providing a resolution but then the story digresses to negative/aggressive/slightly bizarre material but not severe bizarre/ pervasively negative. Or there may be an undoing of the resolution (ex: dog gets lost again at the end). Or resolution is embedded in incoherent action. Or incoherent material is presented before a brief simple resolution. This category is related to "somewhat incoherent/a" but is more severe.

***4b)*** The story is unresolved. The subject appears to be trying to deal with the story problem but is not able to get it together. Story does not form a unified whole or provide even a minimal resolution.

***4c***) The subject may offer a solution to the secondary but not primary problem. In contrast to "Somewhat incoherent/c" the story is disjointed, and/or bizarre, very difficult to understand and/or unclear with little aspects of coherence. Or deal with previous story or modification of stem but there is no resolution.

**5) Somewhat incoherent**: The subject provides a story having some coherence with an resolution. The story may be partly consistent, relevant, reasonable and understandable. However, the story resolution is intermingled with limitations such as: a mild twist to the resolution, initial hesitation to respond along with repeated need for general and specific prompts, a resolution to the secondary but not primary problem, a modification of the story or a story embedded in testing of the interviewer. This category is subdivided into:

***5a)*** The subject presents a story having a resolution with a mild twist. The child may begin the story coherently, but then make one or two disconnected shifts in the story line or may digress from the story line to neutral or slightly negative/aggressive or disjointed material. The story seems to unwind or fall apart after as appropriate start. Or there may be an appropriate beginning & end but fall apart in the middle. The digression does not follow from the story, is not related to the stem. There may be a sudden shift in action and often a sudden emotional shift. Sometimes shift to aggression or strange meaningless action rather than coherent story.

***5b)*** The subject's initial response may be several "I don't know", "no" or a shrug of the shoulder. This initial hesitation to respond may be continued with a need for repeated general and specific prompts and requests for clarification of action. However the story provided addresses the story conflict in a relatively consistent, relevant, reasonable manner, producing a benign resolution. The story is generally very short. The avoidant cases in this category is related to the above "somewhat coherent/b category" but the avoidance is more severe.

***5c)***The subject may offer a resolution to the secondary problem but not the primary problem (ex. soup, monster), however the story may otherwise be quite coherent. Or the subject may change the story significantly to deal with the problem. These changed stories may be connected and consistent with a resolution. Or there may be strong contradiction of monster/no monster.

***5d)*** An appropriate resolved story is embedded in testing, controlling, frustration or anger with the interviewer. There may be a request to return to class.

***5e)*** The subject shows an understanding of the story stem. There may or may not be a minimal resolution of the stem as presented. Instead the majority of the story is coherent but concerned with a modification of the stem. Or the stem itself may not be modified but the coherent story that is provided is related to the stem but does not directly address the stem's core problem. Or there is a coherent, resolved story that is a continuation of a previous story.

**6) Somewhat coherent**: The subject offers a minimal or complete resolution that is for the most part reasonable and benign. However there may be several possible limitations. The somewhat coherent category is subdivided into categories.

***6a)*** The subject demonstrates an understanding of the conflict or problem and offers a minimal but not a complete resolution. The story may have some embellishments or be very short and offer only the minimal amount necessary to tell the story. In either case, the story is in general connected, consistent, and reasonable. There are no digressions or contradictions. There may be several general prompts, specific prompts and requests for clarification of action.

***6b)*** The story may have a minimal or complete resolution with/without embellishments but only with repeated general prompting or repeated request for clarification of action or narration or specific prompting (ex: hurt, spill, monster prompt).

***6c)***The subject may provide a complete resolution but there may be considerable but not severe digression to somewhat relevant material, mild contradictions or shifts, gaps in action, or unclear speech. The digression generally (but not always) occurs at the end of the story. The digressions are neutral, positive or mildly negative. They generally are related in some way to the stem. They do not create a twist to the resolution to the story. The subject may have a difficult time ending the story and may return to telling the story after the feeling prompt.

**7) Coherent**: The subject addresses the story conflict and offers a reasonable, complete resolution. However there may be some relatively minor elements of incoherence: The story may be quite short. There may be the need for some specific or general prompts to encourage narration and drama. Or the story may be coherent but a specific hurt, spill or monster prompt is needed for the subject to provide a complete resolution. Or the action may lack in consistency, unity or connection. There may be some digressions or mild contradictions (however no bizarre or disjointed events). Some effort of interpretation may be required now and then. Or the subject may have minor difficulty ending the story.

**8) Very coherent**: The subject addresses the story conflict without resistance, relates story completions to the story stem and avoids sharp contradictions in the story line and affective tone. The subject presents a plausible sequence of events related to the story stem and does not go off on tangents. The action is connected, consistent, and unified. The subject spontaneously provides a complete, positive resolution (little or no need for prompts) and perhaps a statement indicating the end (such as "all done" or "the end", or sitting back in the chair or taking hands form the figures after presenting drama). The story is neither minimally short nor rambling and lengthy. The plot is to the point. Sufficiently clear information is given to enable the coder to follow the story line without clarifications. The subject may add to the story line, indeed there may be a lot of embellishment, but the subject does not change the original story stem. There are no incoherent shifts or bizarre events in the story. Thoughtful, reflective presentation. The subject may included collaborate comments ("let me think", "well, two things could happen..."). The subject might indicate a distinction between illusion &reality ("no, there wasn't really a monster, it was just..", "he was really scared.. but it was just a nightmare." "she thought her mom & dad didn't like her any more but they really just wanted some time alone". Lastly the subject may share relevant real life experiences that are emotionally consistent with the story being presented

**Security (1-8)**

**1) Disorganized**: Extremely incoherent. Generally the story is unresolved. The story contains bizarre, disjointed events. The story is not logical so that it is very difficult to understand. The presentation may be strange with odd stylized movements, brief frozen, staring moments in the midst of action. Odd personal references. The subject may display intense emotions in face, voice and action. There may be emotional incoherence - sudden unexplained shifts in emotional tone. Inappropriate emotions. There is generally mid- to high investment in performance. The presentation is characterized by dysfluency. The nonverbal state is generally anxious or agitated or disoriented. The interaction with the interviewer may be interactive and assertive or uncooperative and provocative. The representation of the parents is generally (not always) negative.

**2) Severely insecure**

***2a.Severe avoidance***: Very incoherent. Severe avoidance - little or no response. No resolution, indeed no story. Very low investment in performance. Low fluency. Restricted emotion, no knowledge of emotions, may have inappropriate affect. The nonverbal state is tense. The interaction with the interviewer is generally withdrawn. There is usually no representation of the parents.

***2b. Severe ambivalence***: Very incoherent. Unresolved story that is not logical or understandable. There is a series of negative, disjointed or bizarre events. There may be high investment in performance but low fluency. The interaction with the interviewer may be cooperative, interactive/assertive or uncooperative. The nonverbal state is generally agitated. There is intense emotional expression, often inappropriate emotions and emotional shifts. The representation of the parents is usually neutral or negative or mixed.

**3) More insecure**

***3a. More avoidance***: More incoherent. The story is unresolved. There is severe avoidance of the problem of the story. There is low investment in performance, and low fluency. The subject is restrained or withdrawn with the interviewer. The subject displays restricted emotions, perhaps some inappropriate emotion, and sometimes no knowledge of emotion. The representation of the parents is generally either absent, neutral or mixed.

***3b. More ambivalence***: More incoherent. The story may be unresolved or have a very minimal resolution with a twist. There are bizarre, violent themes, disconnected, unreasonable action. The story lacks unity and clarity making it difficult to understand. There may be mid to high investment in performance but low fluency. The subject appears agitated or anxious. The interaction with the interviewer could be assertive and interactive/cooperative or uncooperative. The subject generally displays intense emotions, and often inappropriate emotions. Representation of parents is likely to negative, mixed or neutral.

**4) Insecure**

***4a. Avoidant***: Incoherent. No resolution either because the subject seems to deal with the central problem to some degree but is not able to provide a resolution. Or the subject provides a resolution to the secondary problem but not the primary problem. The resolution given for the secondary problem is disconnected, unreasonable and difficult to understand, perhaps with a sequence of aggression or some bizarre events. The investment is performance is likely to be low to moderate and the fluency is low. The subject generally appears anxious or tense. The interaction with the interviewer may be reluctant, restrained, and uncooperative. There are usually restricted emotions, perhaps some inappropriate emotions and perhaps no knowledge of

emotions. Severe avoidance. There may be negative, neutral or mixed representation of parents.

***4b.Ambivalence***: Incoherent. Resolution with a twist. There may be a minimal resolution followed with (or embedded in) a bizarre, disjointed or aggressive digression. However the degree of bizarre or disjointed or aggression is not severe. There is generally a high investment in performance but low fluency. The interaction with the interviewer is generally interactive or cooperative and perhaps assertive. The subjects displays intense emotions, often inappropriate emotions and no not have knowledge of emotions. The representation of parents is generally negative or mixed.

**5) Secure**

***5a. Secure/avoidant:*** Minimal resolution provided but with initial hesitation, need for several general and/or specific prompts and/or requests for clarification, or coherent resolution to only the secondary problem or coherent modification of the problem. Generally low to mid investment in performance with low to mid fluency. The subject may appear tense or relaxed. The subject may be reluctant or cooperative with interviewer. There may be moderate or restricted expression of emotion (distress may not be expressed), generally has some knowledge of emotions and may display inappropriate emotions. Moderate avoidance. No representation of parents or neutral, mixed.

***5b. Secure/ambivalent***: Subject provides a minimal resolution to the story but with a twist that is disjointed or slightly negative or embedded in testing of the interviewer. There is usually mid to high investment in performance with low to mid fluency. The subject generally appears somewhat anxious. The interaction with the interviewer is usually cooperative (sometimes assertive or uncooperative). The subject displays intense or a full range of emotions with full knowledge of emotions and perhaps inappropriate affect. The representation of parents is likely to be mixed.

**6) More secure**

***6a. More secure (avoidant)***: The story has a minimal resolution that may be very short or presented only with several general, specific prompts or requests for clarification. The investment in performance may be low to mid while the fluency may be low, moderate or high. The subject is likely to appear tense (or relaxed or anxious). The interaction with the interviewer is generally reluctant or cooperative (perhaps assertive or uncooperative). The subject displays restricted or moderate (or perhaps full range of) emotions (may show little distress), generally has knowledge of emotions and little or no inappropriate emotions. Mild avoidance. Positive, mixed, neutral or absent representation of parents.

***6b.More secure (ambivalent):*** Complete or minimal resolution but with digression to relevant material or mild contradictions, shifts, or gaps. There is mid-high investment in performance and generally mid fluency. The subject appears relaxed or anxious. The interaction with the interviewer is likely to be cooperative (perhaps interactive or assertive or controlling). The subject may display full range of emotions, full knowledge of emotions, and perhaps some inappropriate emotions. The representation of parents is likely to be mixed or positive.

**7) Secure**

Coherent. Complete resolution that may have some embellishment or be very simple. There is likely to be mid to high investment in performance and mid-high fluency. The subject generally appears relaxed, at ease with the task and enjoying the presentation. However there may be some anxiety. The subject is cooperative or interactive, perhaps also assertive with the interviewer. The subject is generally emotionally expressive of a full range of affect, (but could be moderate) with full knowledge of emotions and little or no inappropriate emotions.

Representation of parents is likely to be positive or neutral (could be mixed or absent).

**8) Very secure:** Very coherent, logical, connected, relevant. Complete, positive resolution with some embellishment. Subject acknowledges problem and deals with it in constructive, imaginative way. There is generally high investment in performance and high fluency. The subjects appears relaxed and at ease with the issues and enjoying the task. The interaction with the interviewer is generally interactive but sometimes cooperative, and often assertive. The subject is expressive of a range of emotions, has full knowledge of emotion and little or no inappropriate emotional expression. The representation of the parents is likely to be positive or neutral.

**Appendix C: One Example of Picture for Chimeric Face Task and Task Sheet**

**Which face looks happier, top or bottom? Put A “T” or A “B” next to the number.**

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____

**Appendix D: Emotion Pictures Used In the Emotion Recognition Protocol and Task Sheet**

1) Happiness

2) Anger

3) Neutral

4) Surprise

**5)** Sadness

6) Fear

7) Disgust

| Child:<br>Classroom:<br>Year:<br>Interviewer: | Image 1 | Image 2 | Image 3 | Image 4 | Image 5 | Image 6 | Image 7 |
|---|---|---|---|---|---|---|---|
| 1. Can you tell me how does she/he (the child) feel? | | | | | | | |
| 2. Why do you think so? | | | | | | | |

## Appendix E: Observation Coding Sheet for Emotion Expression and Social Initiation

Date:_____Observer:

Class: Round # (today): _____# Children present _____

Child1._____

Child2._____

Child3._____

Child4._____

Child5._____

Child6._____

Child7._____

Child8._____

Child9._____

Child10._____

Child11._____

Child12._____

Child13._____

Child14._____

Child15._____

Note: You are to look at each child every 6 seconds and note whether he or she is exhibiting positive affect (noted as a "+"), negative affect (noted as a "-") or neutral affect (noted as a "0") (starting with the first child, then the second child, then the third child, etc.) When you get through the entire class roster this is considered a "round" of observation. Complete as many rounds as possible during your observation period. Positive affect includes smiles, laughs, high curiosity; negative affect includes frowns, sighs, crying, anger expressions; and neutral expressions are any expressions that are not clearly positive or negative.

The Observation Coding Sheet for Initiation of Social Interaction

Date:_____Observer:

Class: Round # (today): _____# Children present _____

Child1._____

Child2._____

Child3._____

Child4._____

Child5._____

Child6._____

Child7._____

Child8._____

Child9._____

Child10._____

Child11._____

Child12._____

Child13._____

Child14._____

Child15._____

Note: You are to observe the target child for a period of **15-sec.** noting each classmate and/or adult with whom the target interacts. Indicate the tone of each interaction as **prosocial or positive** (generally play, friendly conversation, or giving/requesting assistance or rough and tumble play using a plus (+) sign; as **antisocial or negative** (generally struggles over objects or positions, teasing with a hostile intent, provoked or unprovoked hostile acts such as hitting or kicking, or intruding on the play activity of another) using a negative (-) sign, or as socially neutral (generally conversation without obvious playful undertones such as responding to a teacher directive or idle chatter with another child, or physical interactions not easily identified as prosocial or antisocial using a zero (0). Indicate also the initiator of the interaction by putting a capitol "I" before the child's name if your target is the initiator and after the child's name if the child named is the initiator. Finally, at the end fo the interval, name and circle the nearest child neighbor of the target. *Remember, if the target is actively interacting with another child at the end of the interval,call the interactive partner the nearest neighbor, even if some other child is physically closer.*

**Appendix F:**
**The Behavioral Rating Inventory of the Executive Functioning-Preschool Version (BRIEF-P; Gioia, Espy, & Isquith, 2003)**

*Directions*: Below is a list of behaviors. For each one, think about how often each of these behaviors has been a problem for your student during the last six months. Use the scale below to fill in the corresponding circle on your scantron.

A=Never, B=Sometimes, C=Often

1. Overreacts to small problems
2. When given two things to do, remembers only the first or last
3. In unaware of how his/her behavior affects or bothers others
4. When instructed to clean up, puts things away in a disorganized, random away
5. Becomes upset with new situations
6. Has explosive, angry outbursts
7. Has trouble carrying out the actions needed to complete tasks (such as trying one puzzle piece at a time, or cleaning up to earn a reward)
8. Does not stop laughing at funny things or events when others stop
9. Needs to be told to begin a task even when willing to do it
10. Has trouble adjusting to new people (such as babysitter, teacher, friend or day care worke r)
11. Becomes upset too easily
12. Has trouble concentrating on games, puzzles, or play activities
13. Has to be more closely supervised than similar playmates
14. When sent to get something, forgets what s/he is supposed to get
15. Is upset by a change n plans or routine (for example, order of daily activities, adding last-minute errands to schedule, change in driving route to store)
16. Has outbursts for little reason
17. Repeats the same mistakes over and over even after help is given
18. Acts wilder or sillier than others in groups (such as birthday parties, play group)
19. Cannot find clothes, shoes, toys, or books even when s/he has been given specific instruct ions
20. Takes a long time to feel comfortable in new place or situations (such as visiting distant r

elatives or new friends)

21. Mood changes frequently
22. Makes silly mistakes on things s/he can do
23. Is fidgety, restless, or squirmy
24. Has trouble following established routines for sleeping, eating, or play activities
25. Is bothered by loud noises, bright lights, or certain smells
26. Small events trigger big reactions
27. Has trouble with activities or tasks that have more than one step
28. Is impulsive
29. Has trouble thinking of a different way to solve a problem or complete an activity when s tuck
30. Is disturbed by changes in the environment (such as new furniture, things n room moved around, or new clothes)
31. Angry or tearful outbursts are intense but end suddenly
32. Needs help from adult to stay on task
33. Does not notice when his/her behavior causes negative reactions
34. Leaves messes that others have to clean up even after instruction
35. Has trouble changing activities
36. Reacts more strongly to situations than other children
37. Forgets what s/he is doing in the middle of an activity
38. Does not realize that certain actions bother others
39. Gets caught up in the small details of a task or situation and misses the main idea
40. Has trouble "joining in" at unfamiliar social events (such as birthday parties, picnics, holi day gatherings)
41. Is easily overwhelmed or overstimulated by typical daily activities
42. Has trouble finishing tasks (such as games, puzzles, pretend play activities)
43. Gets out of control more than playmates
44. Cannot find things in room or play area even when given specific directions
45. Resists change of routine, foods, places, etc.
46. After having a problem, will stay disappointed for a long time
47. Cannot stay on the same topic when talking

48. Talks or plays too loudly
49. Does not completed tasks even after given directions
50. Acts overwhelmed or overstimulated in crowded, busy situations (such as lots of noise, a ctivity, or people)
51. Has trouble getting started on activities or tasks even after instructed
52. Acts too wild or out of control
53. Does not try as hard as his/her ability on activities
54. Has trouble putting the brakes on his/her actions even after being asked
55. Unable to finish describing an event, person or story
56. Completes tasks or activities too quickly
57. Is unaware when s/he does well and not well
58. Gets easily sidetracked during activities
59. Has trouble remembering something, even after a brief period of time
60. Becomes too silly
61. Has a short attention span
62. Plays carelessly or recklessly in situations where s/he could be hurt (such as playground, swimming pool)
63. Is unaware when s/he performs a task right or wrong

## Note

In this study, data from preschool children is nested within 10 classrooms. Because the important problem of studying nested data is the dependence of the observations at the low levels, we would like to use hierarchical linear model (multilevel model) which is the best statistical tool for accounting for this problem (Raudenbush & Bryk, 2002). However, researchers have argued that a sufficient sample size is crucial for accurate estimation in hierarchical linear model (Cohen, 1998; Mass & Hox, 2005; Raudenbush & Bryk, 2002). Specifically, Kreft (1996) and several researchers recommended that a sample of 30 groups with 30 individuals is necessary for accurate estimation in HLM (Goldstein, 1995; Kreft, 1996; Van Der Leeden, Busing, & Meijer, 1997). Although recent study has revealed that the 30/30 rule of Kreft (1996) is not necessary (Mass & Hox, 2005), the sample size in this study is too small ($N = 65$, 10 classrooms) for conducting HLM compared to optimal sample size for HLM. In addition, HLM is not appropriate for this data because multiple imputations were used (multiple imputations are based on a predicted distribution which assumes dependence of all individuals and variables in the study) and the sample size for each classroom is too small (e.g., 3 for one classroom) (statistical consulting from the department of statistics, April 19, 2011). Thus, we standardized the variables which were obtained in class observation (emotion expression and social initiation) but did not utilize HLM.